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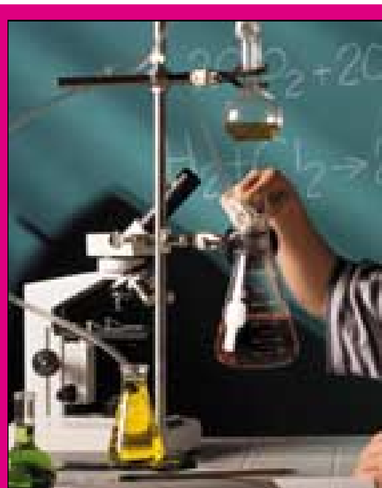
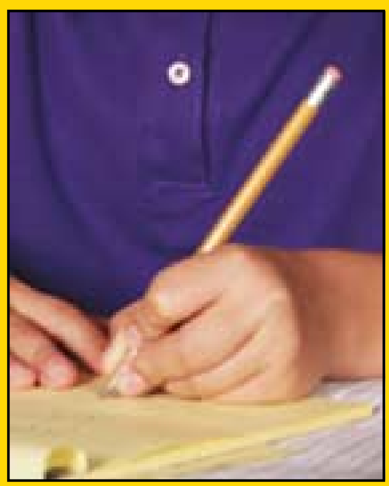
NAEP 1996 Trends in Academic Progress





Achievement of U.S. Students in
• Science, 1969 to 1996 • Mathematics, 1973 to 1996 • Reading, 1971 to 1996

THE NATION'S REPORT CARD naep

Prepared by Educational Testing Service under a cooperative agreement with the National Center for Education Statistics

U.S. Department of Education
Office of Educational Research and Improvement NCES 97–985r

What is The Nation's Report Card?

THE NATION'S REPORT CARD, the National Assessment of Educational Progress (NAEP), is the only nationally representative and continuing assessment of what America's students know and can do in various subject areas. Since 1969, assessments have been conducted periodically in reading, mathematics, science, writing, history/geography, and other fields. By making objective information on student performance available to policymakers at the national, state, and local levels, NAEP is an integral part of our nation's evaluation of the condition and progress of education. Only information related to academic achievement is collected under this program. NAEP guarantees the privacy of individual students and their families.

NAEP is a congressionally mandated project of the National Center for Education Statistics, the U.S. Department of Education. The Commissioner of Education Statistics is responsible, by law, for carrying out the NAEP project through competitive awards to qualified organizations. NAEP reports directly to the Commissioner, who is also responsible for providing continuing reviews, including validation studies and solicitation of public comment, on NAEP's conduct and usefulness.

In 1988, Congress established the National Assessment Governing Board (NAGB) to formulate policy guidelines for NAEP. The Board is responsible for selecting the subject areas to be assessed from among those included in the National Education Goals; for setting appropriate student performance levels; for developing assessment objectives and test specifications through a national consensus approach; for designing the assessment methodology; for developing guidelines for reporting and disseminating NAEP results; for developing standards and procedures for interstate, regional, and national comparisons; for determining the appropriateness of test items and ensuring they are free from bias; and for taking actions to improve the form and use of the National Assessment.

The National Assessment Governing Board

NATIONAL CENTER FOR EDUCATION STATISTICS

NAEP 1996 Trends in Academic Progress

Achievement of U.S. Students in

• **Science, 1969 to 1996** • **Mathematics, 1973 to 1996**
• **Reading, 1971 to 1996**

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REVISED
July 2000

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July 2000

This report is a revision of *NAEP 1996 Trends in Academic Progress* (NCES 97–985, NCES 98–531). It contains minor revisions to the text, tables, and figures. The results of the long-term trend writing assessment have been deleted. These data are under review and will be rereleased at a future date.

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Table of Contents

PART I: Science

PART II: Mathematics

PART III: Reading

Executive Summary

This revised version of the 1996 NAEP long-term trends report contains data that have been corrected since the release of the original report. The section containing long-term trend writing assessment results, which appeared in the original report as Chapters 7 and 8, has been removed from this revised version. These data are under review and will be rereleased at a future date.

Introduction

As we approach the year 2000, efforts to increase the academic achievement of students and to prepare them for the 21st century have become a primary focus of parents, educators, and policy makers. During the 1990s, educational reform and increased expectations for all students to achieve their highest potential have been the hallmark of policies and programs set forth at the national, state, and district levels. In 1990, the President and governors adopted a set of six ambitious national education goals for the 21st century: ensuring that children start school ready to learn, raising high school graduation rates, increasing levels of education achievement, promoting science and mathematics achievement as well as literacy and lifelong learning, and freeing schools of drugs and violence.[1] Congress broadened these goals in 1994 to include improvements in teacher preparation and increased parental involvement in schools.[2] In 1997, the President strengthened the nation's commitment to rigorous education standards by proposing a voluntary program of national tests in reading at grade 4 and in mathematics at grade 8 to ensure that individual students across the country are provided equal opportunities to achieve high standards in these critical subject areas.

As new policies are implemented and changes in educational practices occur, information about trends in student achievement across time is critical for educators and policy makers to observe the overall effects of reform efforts. Measuring students' progress toward higher achievement has been the purpose of the National Assessment of Educational Progress (NAEP) since its inception in 1969. Students in both public and nonpublic schools have been assessed in various subject areas on a regular basis. In addition, NAEP collects information about relevant background variables that provide a meaningful context for interpreting the assessment results and for documenting the extent to which educational reform has been implemented.

[1] Executive Office of the President. (1990). *National goals for education.* Washington, DC: U.S. Government Printing Office.

[2] Goals 2000: Educate America Act, Pub. L. No. 102-227 (1994).

The NAEP Long-Term Trend Assessments

One important feature of NAEP is its ability to document trends in academic achievement in core curriculum areas over an extended period of time. By readministering materials and replicating procedures from assessment to assessment, NAEP collects valuable information about progress in academic achievement and about whether the United States can meet the challenge of its national education goals.

The NAEP long-term trend assessments are separate from a series of newer NAEP assessments (called "main" assessments) that involve more recently developed instruments. While the long-term trend assessments have used the same sets of questions and tasks so that trends across time can be measured, the main assessments in each subject area have been developed to reflect current educational content and assessment methodoloy. In some cases, the main assessment in a particular subject area has been administered in more than one year, providing short-term trend results (e.g., mathematics in 1990, 1992, and 1994; and reading in 1992 and 1994). The use of both long-term trend and main assessments allows NAEP to provide information about students' achievement over time and to evaluate their attainment of more contemporary educational objectives. As each assessment is based on a different set of questions and tasks, scale score results and students' reports of educationally related experiences from the long-term trend assessments cannot be directly compared to the main assessments.

The following sections of this report present the results of the science, mathematics, and reading trend assessments.[3] These results chart trends going back to the first year in which each NAEP assessment was given: 1969/1970 in science, 1973 in mathematics, and 1971 in reading. Trends in average performance over these time periods are discussed for students at ages 9, 13, and 17. Trends in average performance differences between White students and Black students, White students and Hispanic students, and male and female students are also discussed.

Analysis Procedures

To provide a numeric summary of students' performance on assessment questions and tasks, NAEP uses a 0-to-500 scale for each subject area. Comparisons of average scale scores are provided across the years in which trend assessments have been administered and among subpopulations of students. Nationally representative samples totaling approximately 30,000 students were involved in the NAEP 1996 trend assessments.

The descriptions of trend results are based on the results of statistical tests that consider both the estimates of average performance in each assessment year as well as the degree of uncertainty associated with these estimates. The purpose of basing descriptions on such tests is to restrict the discussion of observed trends and group differences to those that are

[3] Results of the 1996 long-term trend writing assessment are not included in this revised report due to ongoing examination and reanalysis of the writing data.

statistically dependable. Hence, the patterns of results that are discussed are unlikely to be due to the chance factors associated with the inevitable sampling and measurement errors inherent in any large-scale survey effort like NAEP. Throughout this report, all descriptions of trend patterns, differences between assessment years, and differences between subgroups of students which are cited are statistically significant at the .05 level.

Two distinct sets of statistical tests were applied to the trend results. The purpose of the first set of tests was to determine whether the results of the series of assessments in a given subject could be generally characterized by a line or a simple curve. Simple linear and curvilinear (or quadratic) patterns do not always provide a satisfactory summary description of the patterns of trend results. Hence, a second set of statistical tests were conducted which compared results for selected pairs of assessment years within each trend sequence. Two families of pairwise tests were carried out. One family of tests consisted of comparing the results from the first assessment year (base year) to the 1996 results. The second family of tests consisted of comparing the results from the previous assessment year (1994) to the 1996 results. It should be noted that statistically significant changes in student performance across a two-year period may be unlikely, and in fact, are not evident in the overall results or in the results for most subgroups of students presented in this report. Changes in the average achievement of populations or subpopulations are more likely to occur over extended periods of time. In addition, the inherent uncertainty associated with estimates of performance based on samples rather than entire populations necessitates consideration of standard errors in comparing assessment results, further constraining the likelihood that the magnitude of change which may occur between two years will be statistically significant. The characterizations of trend data that appear in the executive summary and in the following chapters of this report are based on the combined results of both the general tests and the two families of pairwise tests.

The results of each type of statistical test are presented in small grids that appear next to or below each of the figures in this report that display data for each assessment year. The results from tests comparing the base year and 1996 assessments are summarized in the column labeled with the asterisk symbol "*." Significant differences are denoted with a "+" or "-" sign indicating that the 1996 average score was either greater than or less than the base year score, respectively. Similarly, significant differences between 1994 and 1996 assessment results are denoted with a "+" or "-" sign under the column labeled with the dagger symbol "‡" indicating that the 1996 average score was either greater or smaller than the 1994 average, respectively. The results from the linear and quadratic trend tests are summarized in the columns labeled "L" and "Q," respectively. Within each column, significant positive trends are denoted by a "+" sign and significant negative trends are denoted with a "-" sign. In tables where only the first and most recent assessment results are presented, significant differences between the base year and 1996 are indicated within the tables.

National Trends in Average Scale Scores

The national trends in science, mathematics, and reading achievement are presented in Figure 1. In general, the trends in science and mathematics show early declines or relative stability followed by improved performance. Some modest improvement was evident in the trend reading assessments.

Science. The overall pattern of performance in science for 9-, 13-, and 17-year-olds is one of early declines followed by a period of improvements. Among 17-year-old students, declines in performance that were observed from 1969 to 1982 were reversed, and the trend has been toward higher average science scores since that time. Despite these recent gains, the 1996 average score remained lower than that in 1969. After a period of declining performance from 1970 to 1977, the trend for 13-year-olds has been one of increasing scores. Although the overall linear trend was positive, there was no significant difference between the 1996 and 1970 average scores for these students. Except for the decline from 1970 to 1973 in average science scores for 9-year-olds, the overall trend shows improved performance, and the 1996 average score for these students was higher than that in 1970.

Mathematics. At all three ages, trend results indicate overall improvement in mathematics across the assessment years. Among 17-year-olds, declining performance during the 1970s and early 1980s was followed by a period of moderate gains. Although the overall pattern is one of increased performance, the average score in 1996 was not significantly different from that in 1973. The performance of 13-year-olds across the trend assessments shows overall improvement, resulting in a 1996 average score that was higher than the 1973 average. After a period of relative stability during the 1970s and early 1980s, 9-year-olds demonstrated improved performance. The overall trend for this age group was one of improved performance, and the average score in 1996 was higher than that in 1973.

Reading. At age 17, the pattern of increases in average reading scores from 1971 to 1988 was not sustained into the 1990s. Although the overall pattern is one of improved performance across the assessment years, the average score of 17-year-olds in 1996 was not significantly different from that of their counterparts in 1971. Thirteen-year-olds have shown moderate gains across the trend assessments, and in 1996 attained an average score that was higher than that in 1971. The performance of 9-year-olds improved from 1971 to 1980, but declined slightly since that time. However, in 1996 the average score for these students remained higher than that of their counterparts in 1971.

Figure 1

Trends in Average Scale Scores for the Nation

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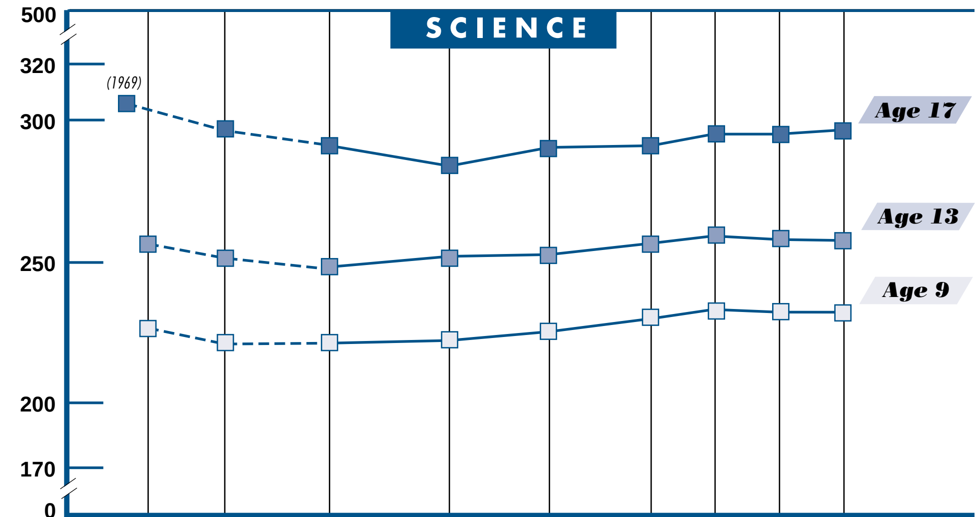
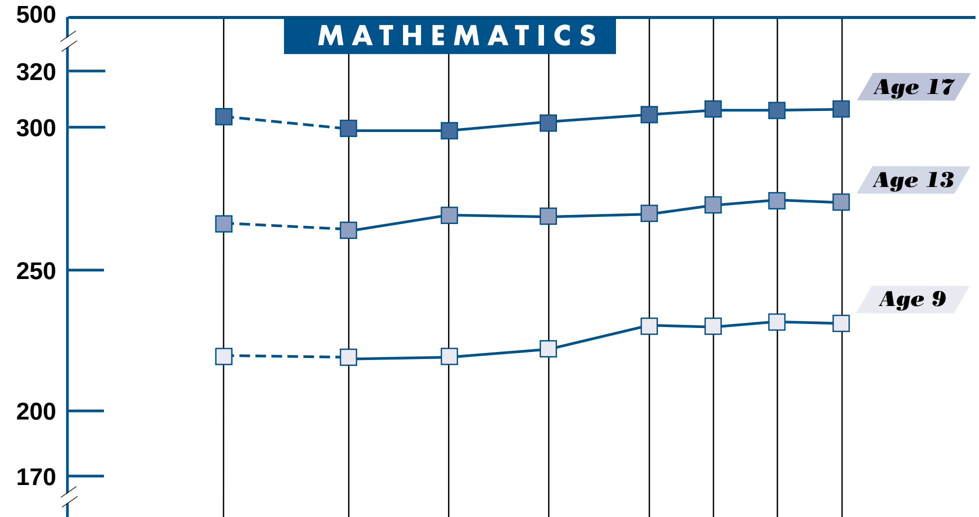


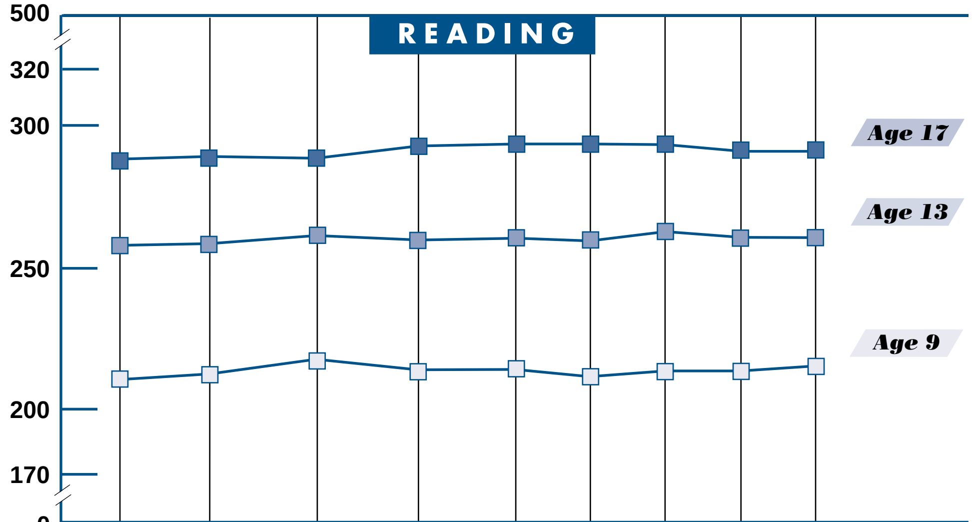
	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	305 (1.0)	296 (1.0)	290 (1.0)	283 (1.2)	289 (1.4)	290 (1.1)	294 (1.3)	294 (1.6)	296 (1.2)	–		–	+
Age 13	255 (1.1)	250 (1.1)	247 (1.1)	250 (1.3)	251 (1.4)	255 (0.9)	258 (0.8)	257 (1.0)	256 (1.0)			+	+
Age 9	225 (1.2)	220 (1.2)	220 (1.2)	221 (1.8)	224 (1.2)	229 (0.8)	231 (1.0)	231 (1.2)	230 (1.2)	+		+	+



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	304(1.1)	300(1.0)	299(0.9)	302(0.9)	305(0.9)	307(0.9)	306(1.0)	307(1.2)			+	+
Age 13	266(1.1)	264(1.1)	269(1.1)	269(1.2)	270(0.9)	273(0.9)	274(1.0)	274(0.8)	+		+	
Age 9	219(0.8)	219(0.8)	219(1.1)	222(1.0)	230(0.8)	230(0.8)	231(0.8)	231(0.8)	+		+	+

Figure 1 (continued)

Trends in Average Scale Scores for the Nation



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	285(1.2)	286(0.8)	286(1.2)	289(0.6)	290(1.0)	290(1.1)	290(1.1)	288(1.3)	288(1.1)			+	–
Age 13	255(0.9)	256(0.8)	259(0.9)	257(0.5)	258(1.0)	257(0.8)	260(1.2)	258(0.9)	258(1.0)	+		+	
Age 9	208(1.0)	210(0.7)	215(1.0)	211(0.7)	212(1.1)	209(1.2)	211(0.9)	211(1.2)	213(1.0)	+			–

Standard errors of the estimated scale scores appear in parentheses. [– – –] Extrapolated from previous NAEP analyses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in the first assessment year.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Levels of Performance

A more in-depth understanding of students' academic progress across time can be gained by examining the types of abilities associated with different levels on the NAEP scale and the percentages of students who have attained those levels of performance across the trend assessments. Five levels of performance have been identified and described on the NAEP scale for each subject area: 150, 200, 250, 300, and 350.[4] The procedure for describing the five performance levels was the same in science, mathematics, and reading. Sets of questions were identified that were more likely to be answered correctly by students at one level than by those at the next lower level. Educators and curriculum experts representing each of the subject areas then carefully studied the sets of questions to develop descriptions for the five levels. These descriptions outline the concepts, skills, or processes demonstrated by correct responses to the questions at each level.

[4] In theory, performance levels above 350 and below 150 could have been defined; however, so few students in the assessment performed at the extreme ends of the subject-area scales that it was not practical to do so.

Information about trends in students' attainment of performance levels is available back to 1977 in science, 1978 in mathematics, and 1971 in reading. Tables 1 through 3 present the percentages of students performing at or above each of the five levels in the first assessment year for which performance level data are available and in the 1996 assessment. In addition, the tables provide summary descriptions that characterize students' performance at each level.

Science. At age 9, the percentages of students attaining at least Levels 150, 200, 250, and 300 on the science scale increased between 1977 and 1996. Increases were also apparent in the percentages of 13-year-olds attaining at least Levels 150, 200, and 250. Although no significant increases were observed for 17-year-olds at the lower levels, the vast majority of students in this age group demonstrated the skills associated with these levels in both 1977 and 1996. At Level 300 there was a significant increase between 1977 and 1996.

Mathematics. Similar to trends observed in science, the percentages of 9-year-olds at or above Levels 150, 200, 250, and 300 on the mathematics scale were higher in 1996 than in 1978. At age 13, nearly all students attained at least Levels 150 and 200 in both 1978 and 1996. There was an increase between the two assessment years in the percentages of 13-year-olds at or above Levels 200 and 250. Among 17-year-olds, performance at or above Levels 150, 200, and 250 was attained by nearly all students in both 1978 and 1996. The percentage of 17-year-old students reaching at least Levels 250 and 300 was higher in 1996 than in 1978.

Reading. In comparison to the assessment results in 1971, greater percentages of 9-year-olds in 1996 attained at least Levels 150 and 200 on the reading scale. At age 13, most students performed at or above the two lowest levels, 150 and 200, in both 1971 and 1996. Increases were observed between the two assessment years in the percentages of 13-year-olds performing at or above Levels 300 and 350. The vast majority of 17-year-olds attained at least Levels 150, 200 and 250 in both 1971 and 1996. The percentages of 17-year-old students at or above Levels 200 and 250 were higher in 1996 than in 1971.

Table 1 — Percentages of Students Performing At or Above Science Performance Levels, Ages 9, 13, and 17, 1977 and 1996

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Level		AGE 9		AGE 13		AGE 17	
		Percent in 1977	Percent in 1996	Percent in 1977	Percent in 1996	Percent in 1977	Percent in 1996
350	Can infer relationships and draw conclusions using detailed scientific knowledge	0 (0.0)	0 (0.1)	1 (0.1)	0 (0.2)	9 (0.4)	11 (1.0)
300	Has some detailed scientific knowledge and can evaluate the appropriateness of scientific procedures	3 (0.3)	4 (0.4) *	11 (0.5)	12 (0.7)	42 (0.9)	48 (1.3) *
250	Understands and applies general information from the life and physical sciences	26 (0.7)	32 (1.3) *	49 (1.1)	58 (1.1) *	82 (0.7)	84 (0.9)
200	Understands some simple principles and has some knowledge, for example, about plants and animals	68 (1.1)	76 (1.2) *	86 (0.7)	92 (0.8) *	97 (0.2)	98 (0.3)
150	Knows everyday science facts	94 (0.6)	97 (0.4) *	99 (0.2)	100 (0.1) *	100 (0.0)	100 (***)

Standard errors of the estimated percentages appear in parentheses. When no standard error appears (***), standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions. In these cases statistical tests have not been conducted. (See Procedural Appendix.)

* Indicates that the percentage in 1996 is significantly different than that in 1977.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Table 2 — Percentages of Students Performing At or Above Mathematics Performance Levels, Ages 9, 13, and 17, 1978 and 1996

Level		AGE 9		AGE 13		AGE 17	
		Percent in 1978	Percent in 1996	Percent in 1978	Percent in 1996	Percent in 1978	Percent in 1996
350	Can solve multistep problems and use beginning algebra	0 (***)	0 (***)	1 (0.2)	1 (0.1)	7 (0.4)	7 (0.8)
300	Can compute with decimals, fractions, and percents; recognize geometric figures; solve simple equations; and use moderately complex reasoning	1 (0.1)	2 (0.3) *	18 (0.7)	21 (1.2)	52 (1.1)	60 (1.7) *
250	Can add, subtract, multiply, and divide using whole numbers, and solve one-step problems	20 (0.7)	30 (1.0) *	65 (1.2)	79 (0.9) *	92 (0.5)	97 (0.4) *
200	Can add and subtract two-digit numbers and recognize relationships among coins	70 (0.9)	82 (0.8) *	95 (0.5)	99 (0.2) *	100 (0.1)	100 (***)
150	Knows some addition and subtraction facts	97 (0.3)	99 (0.2) *	100 (0.1)	100 (***)	100 (***)	100 (***)

Standard errors of the estimated percentages appear in parentheses. When no standard error appears (***), standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions. In these cases statistical tests have not been conducted. (See Procedural Appendix.)

* Indicates that the percentage in 1996 is significantly different than that in 1978.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Table 3 — Percentages of Students Performing At or Above Reading Performance Levels, Ages 9, 13, and 17, 1971 and 1996

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Level		AGE 9		AGE 13		AGE 17	
		Percent in 1971	Percent in 1996	Percent in 1971	Percent in 1996	Percent in 1971	Percent in 1996
350	Can synthesize and learn from specialized reading materials	0 (***)	0 (***)	0 (0.0)	1 (0.2) *	7 (0.4)	7 (0.8)
300	Can find, understand, summarize, and explain relatively complicated information	1 (0.1)	1 (0.2)	10 (0.5)	14 (1.0) *	39 (1.0)	39 (1.4)
250	Can search for specific information, interrelate ideas, and make generalizations	16 (0.6)	17 (0.8)	58 (1.1)	60 (1.3)	79 (0.9)	82 (0.8) *
200	Can comprehend specific or sequentially related information	59 (1.0)	64 (1.3) *	93 (0.5)	92 (0.7)	96 (0.3)	98 (0.5) *
150	Can carry out simple, discrete reading tasks	91 (0.5)	94 (0.6) *	100 (0.0)	100 (0.2)	100 (0.1)	100 (***)

Standard errors of the estimated percentages appear in parentheses. When no standard error appears (***), standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions. In these cases statistical tests have not been conducted. (See Procedural Appendix.)

* Indicates that the percentage in 1996 is significantly different than that in 1971.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Differences in Average Scale Scores Between Racial/Ethnic Groups of Students and Between Males and Females

As noted earlier, one of the national educational goals calls for increases in students' academic achievement. A stated objective of this goal is that the performance distribution for minority students will more closely reflect that of the student population as a whole.[5] In some of the subject areas assessed by NAEP, results indicated progress toward meeting this goal. Trends in the differences between average scores for subgroups of students are presented below.

Differences between White and Black Students. Although in 1996 White students attained higher average scores than their Black peers in each age group across the three subject areas, there was some indication that the gaps between White and Black students' average scores have narrowed across the assessment years.

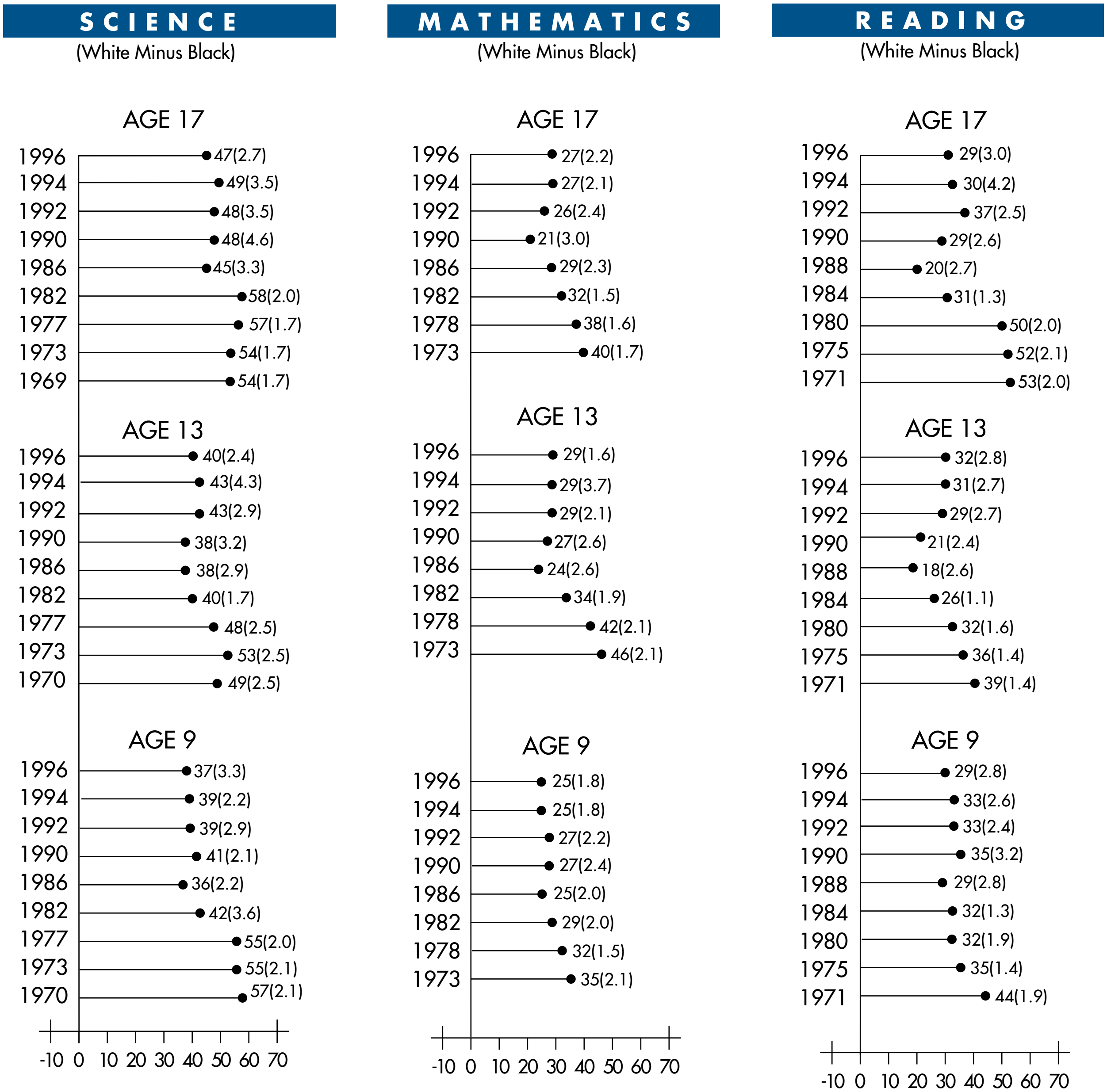
In science, the trend toward smaller gaps among 17-year-olds is due predominately to a one-time decrease in the gap between 1982 and 1986. The narrowing of the gap between average scores of White and Black students aged 9 and 13 occurred in the late 1970s or 1980s. Although there has been little change in the 1990s, for all three ages the gaps in 1996 were smaller than those in 1970.

In mathematics and reading, scale score gaps between White and Black students aged 13 and 17 narrowed during the 1970s and 1980s. Although there was some evidence of widening gaps during the late 1980s and 1990s, the scale score gaps in 1996 were smaller than those in the first assessment year for 13- and 17-year-olds in mathematics and for 17-year-olds in reading. Among 9-year-olds, scale score gaps in mathematics and reading have generally decreased across the assessment years, resulting in smaller gaps in 1996 compared to those in the first assessment year.

[5] Executive Office of the President. (1990). *National goals for education.* Washington, DC: U.S. Government Printing Office.

Figure 2

Trends in Differences in Average Scale Scores
White vs. Black Students



Science

	*	‡	L	Q
Age 17	–		–	
Age 13	–		–	+
Age 9	–		–	+

Mathematics

	*	‡	L	Q
Age 17	–		–	+
Age 13	–		–	+
Age 9	–		–	

Reading

	*	‡	L	Q
Age 17	–		–	+
Age 13			–	+
Age 9	–		–	

Standard errors of the estimated scale score differences appear in parentheses.

* Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in the first assessment year.

‡ Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Differences between White and Hispanic Students. In 1996, White students had higher average scores than Hispanic students at all three ages in each of the three subject areas. Some significant changes in the magnitude of the gap between White and Hispanic students' average scores have occurred across the assessment years.

In science, there was some evidence that the gap between White and Hispanic 13-year-olds' average scores decreased between 1977 and 1982, but the gap has changed little since that time. The gap in the current year, 1996, among 13-year-olds was significantly different from that in 1977.

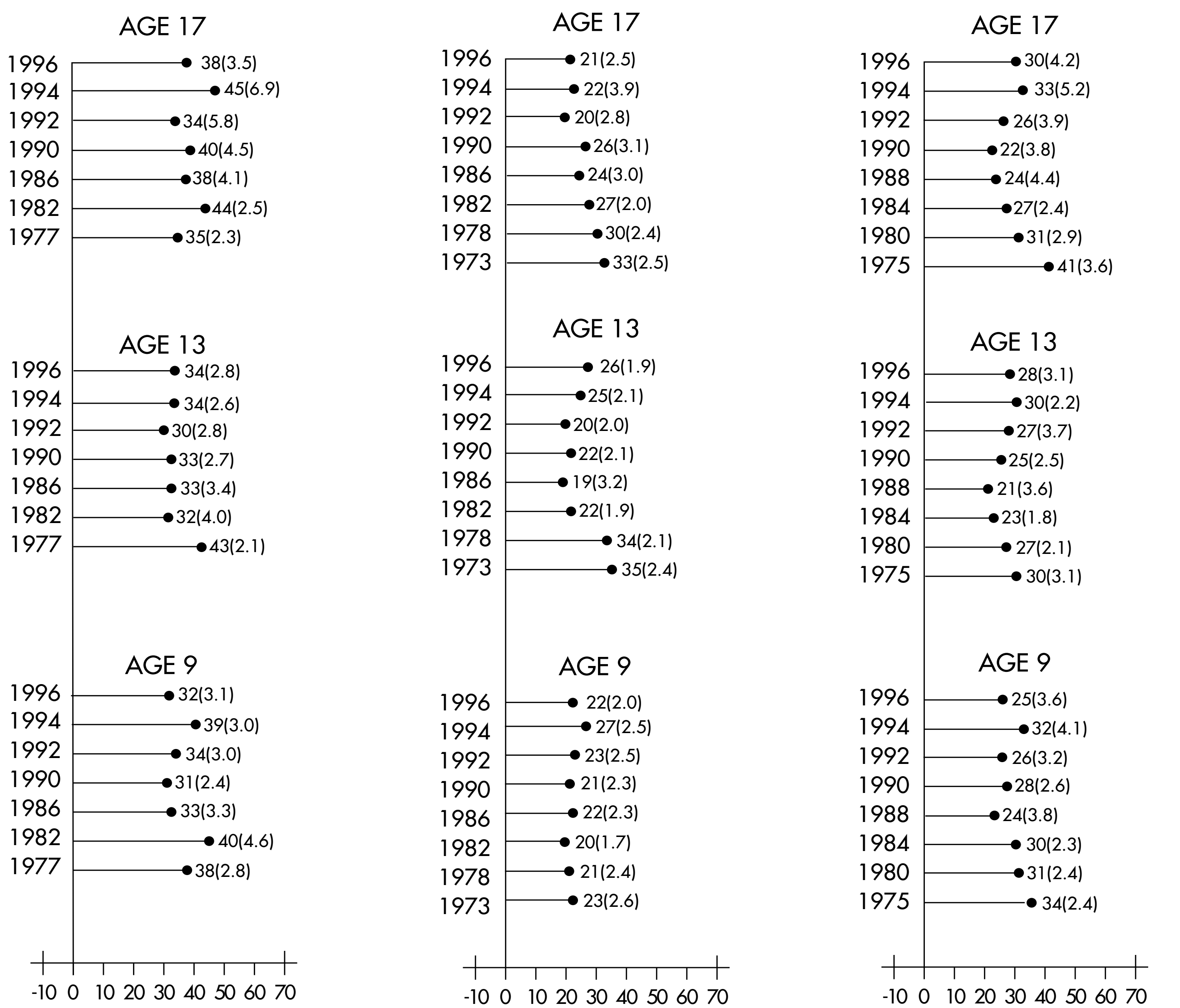
In mathematics, the gap among 17-year-olds has generally decreased across the assessment years, resulting in a gap in 1996 that was lower than that in 1973. At age 13, the gap in mathematics scores decreased from 1973 to 1986. Although the gap appears to have widened somewhat since that time, the gap in 1996 was smaller than that in 1973.

In reading, scale scores gaps among 17-year-olds decreased from 1975 to 1990. However, recent assessment results revealed some widening of the gap, and in 1996 the gap was not significantly different from that in 1975.

Figure 3

Trends in Differences in Average Scale Scores
White vs. Hispanic Students

SCIENCE (White Minus Hispanic) | **MATHEMATICS** (White Minus Hispanic) | **READING** (White Minus Hispanic)



Science

	*	‡	L	Q
Age 17				
Age 13	–			
Age 9				

Mathematics

	*	‡	L	Q
Age 17	–		–	
Age 13	–		–	+
Age 9				

Reading

	*	‡	L	Q
Age 17				+
Age 13				
Age 9				

Standard errors of the estimated scale score differences appear in parentheses.

* Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in the first assessment year.

‡ Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Differences between Males and Females. In 1996, the differences between average scores of male and female students varied across the three subject areas. In mathematics, male students outperformed female students in each age group. In science average scores for males students were higher than those for female students at ages 13 and 17, but there was no significant difference at age 9. In reading, the results were reverse, with female students outperforming male students in each age group. Some changes were observed across the assessment years in the performance differences between males and females.

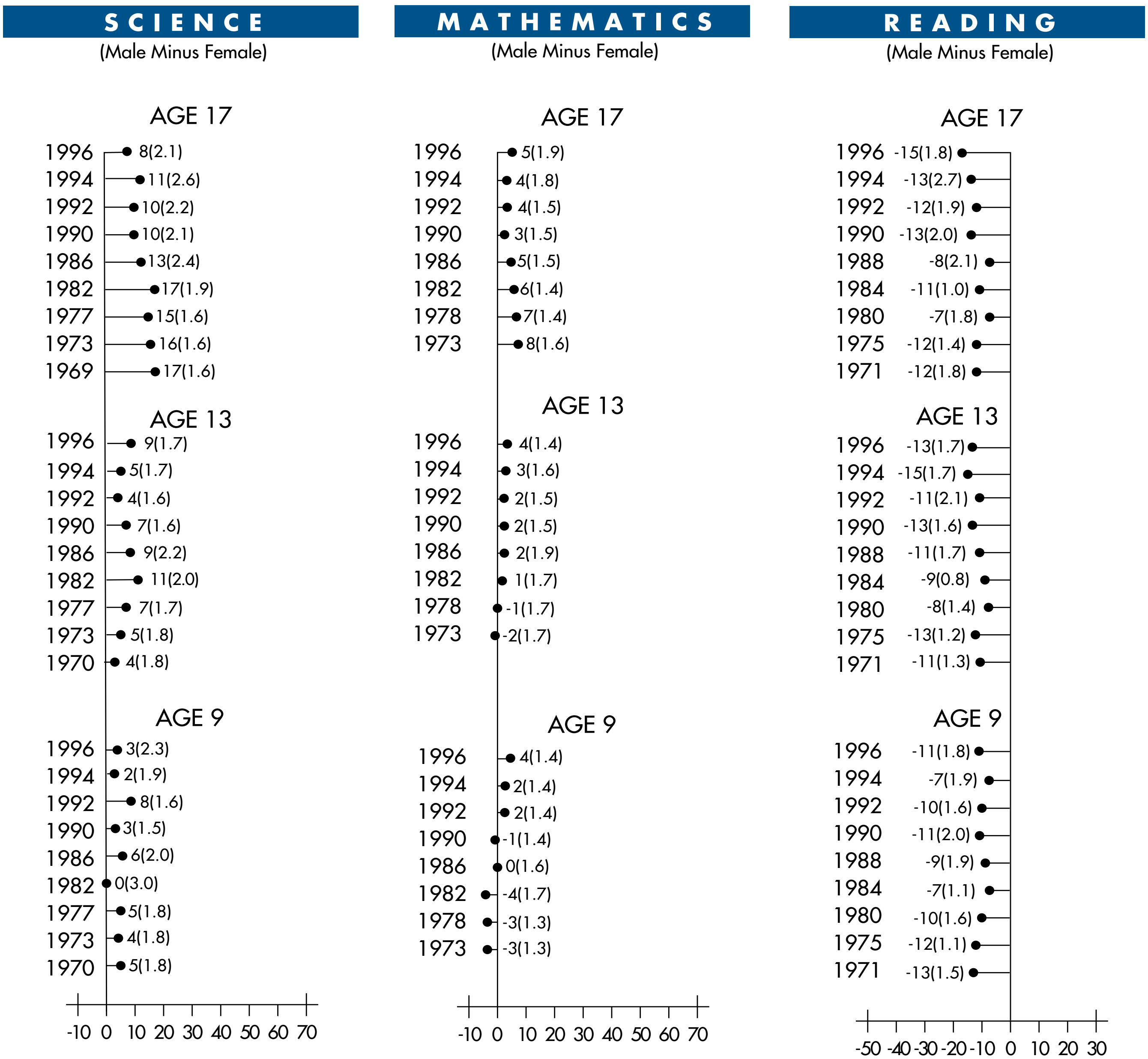
In science, the overall trend at age 17 was one of narrowing gaps between male and female students, due primarily to a decrease that occurred after 1982. As a result, the gap in 1996 was smaller than that in 1969. At age 13, the gap in science scores widened from 1970 to 1982, narrowed again until 1992, but appears to have widened somewhat in the last two assessments. Despite these fluctuations, the gap in 1996 was not significantly different from that in 1970.

In mathematics, the trend at age 17 was toward smaller gaps across the assessments. However, in 1996 the gap between male and female 17-year-olds was not significantly different from that in 1973. Results across the assessment years for 9- and 13-year-olds in mathematics reveal a small but significant shift in the pattern of score differences between male and female students. At both ages, the trend has been away from higher average scores for female students toward higher average scores for male students.

In reading, the gaps between male and female students aged 13 and 17 narrowed between 1975 and 1980, but have fluctuated or increased somewhat since that time. In 1996, the scale score gap for both age groups was not significantly different from that in 1971.

Figure 4

Trends in Differences in Average Scale Scores
Male vs. Female Students



Science

	*	‡	L	Q
Age 17	–		–	
Age 13				–
Age 9				

Mathematics

	*	‡	L	Q
Age 17			–	
Age 13	+		+	
Age 9	+		+	

Reading

	*	‡	L	Q
Age 17				–
Age 13				–
Age 9				

Standard errors of the estimated scale score differences appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in the first assessment year.

‡ Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Students' Experiences Related to Academic Progress

Students' reports about their school and home experiences related to their learning in the different subject areas provide an important context for understanding trends in academic progress over time. Across the assessment years, NAEP has asked students about these relevant experiences and has examined the relationships between students' reports and their average scale scores. For each school and home factor presented in this report, results from the 1996 assessment are compared with results from the first assessment in which information on that contextual variable was collected.

Science and Mathematics Course Work. The percentages of 13- and 17-year-old students taking more challenging course work in science and mathematics increased over time, although the percentages of students taking the most advanced course work continue to be low.[6] Seventeen-year-old students assessed in 1996 were more likely than those in 1986 to report that they had taken biology and chemistry. However, there was no significant change between the two assessments in the percentage of students who reported taking physics.

Compared to 1986, a higher percentage of 13-year-olds in 1996 reported taking prealgebra and a lower percentage reported taking regular math. As shown in Table 4, there were increases between 1978 and 1996 in the percentages of 17-year-olds who reported that their highest level mathematics course was Algebra II or Precalculus/Calculus. Correspondingly, the percentages of students who reported that their highest level course was either General Mathematics/Prealgebra or Algebra I was lower in 1996 than in 1978.

Table 4 **Highest Level of Mathematics Course Work, Age 17, 1978 and 1996**

THE NATION'S REPORT CARD naep

	Percentage of Students				
	General Mathematics or Prealgebra	Algebra 1	Geometry	Algebra II	Precalculus or Calculus
1996	8 (0.6) *	12 (1.0) *	16 (1.0)	50 (1.6) *	13 (1.1) *
1978	20 (1.0)	17 (0.6)	16 (0.6)	37 (1.2)	6 (0.4)

Standard errors of the estimated percentages appear in parentheses.

* Indicates that the percentage in 1996 is significantly different than that in 1978.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

6 A fuller discussion of science and mathematics course-taking patterns is presented in Chapters 2 and 4.

Technology in the Classroom. Students' reports across the assessment years indicated an increased use of technology. In particular, the use of computers for a variety of classroom activities has risen dramatically.[7] Between 1977 and 1996, there was an increase in the percentage of 9-year-olds who reported using a calculator or thermometer in their classrooms. As shown in Table 5, 13- and 17-year-olds assessed in 1996 were far more likely than those assessed in 1978 to report that they had studied mathematics through computer instruction.

Table 5 **Computer Usage in Mathematics, Ages 13 and 17, 1978 and 1996**

		Percentage of Students Answering "YES"	
		AGE 13	**AGE 17**
Studied mathematics through computer instruction	1996	54 (1.8) *	42 (2.1) *
	1978	14 (0.9)	12 (1.1)

Standard errors of the estimated percentages appear in parentheses.

* Indicates that the percentage in 1996 is significantly different than that in 1978.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

7 A fuller discussion of technology use in classrooms is presented in Chapters 2 and 4.

Homework. The reports of 13- and 17-year-olds about the amount of time they spent each day on homework did not change significantly between 1984 and 1996; however, some changes did occur at age 9. In 1996, the percentage of 9-year-olds who reported that they did not have homework assigned was lower than the percentage in 1984. Correspondingly, the percentage of 9-year-olds who reported doing less than 1 hour of homework each day increased between 1984 and 1996. However, the percentage of students aged 9 who reported doing more than 2 hours of homework decreased.[8]

Students at all three ages were also asked about the number of pages they read each day in school and for homework. As shown in Table 6, although there were no significant changes in the reports of 17-year-olds, the reports of both 9- and 13-year-old students indicated an increase in the number of pages read each day. Between 1984 and 1996, there was an increase in the percentage of 9-year-olds who reported reading more than 20 pages, and a decrease in the percentage who reported reading 5 or fewer pages. Similarly, the reports of 13-year-olds showed an increase in the percentage of students who read more than 20 pages each day, and a decrease in the percentage who reported reading 6 to 10 pages.

Table 6 **Pages Read in School and for Homework Per Day, Ages 9, 13, and 17, 1984 and 1996**

THE NATION'S REPORT CARD naep

		Percentage of Students		
		AGE 9	AGE 13	AGE 17
More than 20 pages	1996	17 (1.0) *	14 (0.7) *	21 (1.1)
	1984	13 (0.4)	11 (0.4)	20 (1.0)
16 to 20 pages	1996	16 (0.9)	13 (0.6)	14 (0.7)
	1984	13 (0.5)	11 (0.2)	14 (0.4)
11 to 15 pages	1996	15 (0.7)	18 (0.8)	18 (0.8)
	1984	14 (0.5)	18 (0.4)	18 (0.3)
6 to 10 pages	1996	25 (1.0)	31 (0.8) *	25 (1.0)
	1984	25 (0.5)	35 (0.5)	26 (0.6)
5 or fewer pages	1996	26 (1.1) *	25 (1.0)	22 (0.8)
	1984	35 (1.0)	27 (0.6)	21 (0.8)

Standard errors of the estimated percentages appear in parentheses.
* Indicates that the percentage in 1996 is significantly different than that in 1984.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[8] A fuller discussion of time spent on homework is presented in Chapter 6.

Home Experiences Related to Learning. Because students' experiences outside of school may have at least as much influence on their academic progress as their classroom experiences, the NAEP trend background questionnaires include questions about home factors related to learning.[9] Between 1984 and 1996, there were no significant changes in 13- and 17-year-old students' reports about the frequency of reading done by other people in their homes. At ages 9, 13, and 17, students' reports indicated a decrease between 1971 and 1996 in the number of different types of reading materials in their homes.

Past NAEP assessments have shown a relationship between achievement and both reading for fun and television watching. As shown in Table 7, there was no significant difference between 1984 and 1996 in 9- and 13-year-old students' reports about the amount of time they spent reading for fun. At age 17, there was a decrease in the percentage of students who reported reading for fun daily and an increase in the percentage who reported that they never read for fun.

Table 7 — **Reading for Fun, Ages 9, 13, and 17, 1984 and 1996**

		Percentage of Students		
		AGE 9	AGE 13	AGE 17
Daily	1996	54 (1.9)	32 (1.9)	23 (2.0) *
	1984	53 (1.0)	35 (1.0)	31 (0.8)
Weekly	1996	27 (1.8)	31 (2.1)	32 (2.7)
	1984	28 (0.8)	35 (1.2)	34 (1.1)
Monthly	1996	8 (1.0)	15 (1.4)	17 (1.5)
	1984	7 (0.6)	14 (0.8)	17 (0.5)
Yearly	1996	3 (0.5)	9 (1.2)	12 (1.6)
	1984	3 (0.3)	7 (0.5)	10 (0.5)
Never	1996	8 (0.8)	13 (1.5)	16 (2.1) *
	1984	9 (0.5)	9 (0.6)	9 (0.6)

Standard errors of the estimated percentages appear in parentheses.
* Indicates that the percentage in 1996 is significantly different than that in 1984.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[9] A fuller discussion of home factors related to learning is presented in Chapter 6.

Students' responses to a question about the amount of time they spend watching television each day show mixed results across the three ages. As shown in Table 8, a greater percentage of 9-year-olds in 1996 than in 1982 reported watching 3 to 5 hours of television every day and a lower percentage reported watching 6 or more hours every day. Although the difference was not significant, the percentage of students who reported watching television for 2 hours or less appeared to increase. These findings suggest that 9-year-olds in 1996 were spending slightly less time watching television than were their counterparts in 1982. The percentage of 13-year-olds who reported watching television 2 hours or less each day decreased, while the percentage who reported watching 3 to 5 hours increased. However, there was a drop in the percentage of 13-year-olds who reported watching 6 or more hours of television. The trend toward increased television watching is more apparent among 17-year-olds. As compared to 1978, a greater percentage of 17-year-old students in 1996 reported watching 3 hours or more of television each day, while a lower percentage reported watching 2 hours or less of television.

Table 8 **Television Watching, Ages 9, 13, and 17, 1978/1982 and 1996**

		Percentage of Students		
		NUMBER OF HOURS WATCHED PER DAY		
		0-2 Hours	3-5 Hours	6 or More Hours
Age 9	1996	47 (1.1)	36 (1.0) *	18 (0.9) *
	1982	44 (1.1)	29 (0.6)	26 (1.0)
Age 13	1996	39 (1.2) *	48 (0.9) *	13 (0.6) *
	1982	45 (0.8)	39 (0.4)	16 (0.8)
Age 17	1996	54 (1.2) *	39 (1.1) *	7 (0.5) *
	1978	69 (0.7)	26 (0.6)	5 (0.2)

Standard errors of the estimated percentages appear in parentheses.

* Indicates that the percentage in 1996 is significantly different than that in 1978 or 1982.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

This Report

A primary purpose of the National Assessment of Educational Progress is to measure trends in academic performance across time. This report, *NAEP 1996 Trends in Academic Progress,* provides a broad examination of students' learning in three core academic areas: science, mathematics, and reading.[10] In addition to overall results, an extensive discussion of the performance of subgroups of students is provided (e.g., racial/ethnic subgroups, males and females). Relevant aspects of students' performance and of home and school factors related to achievement are presented as well.

This report contains five sections. The first three sections correspond to the three subject areas. The first chapter in each subject area section presents overall scale score results for the nation and for subgroups of students, as well as students' attainment of specific performance levels on the NAEP scale. The second chapter in each subject area section discusses students' reports of home and school experiences related to performance. Finally, the report concludes with a Procedural Appendix and a Data Appendix.

[10] Although a long-term trend assessment in writing was conducted in 1996, results from the writing assessment are not presented in this revised report. These data are under review and will be rereleased at a future date.

Part I Science

Introduction

The current emphasis on science reform in the United States is rooted in the report *A Nation at Risk,* issued in 1983 by the National Commission on Excellence in Education.[1] This and other reports published in the 1980s pointed out the deficiencies of the educational system and proposed ways to address them, fueling interest in reform.[2] Since then, governmental, professional, and private organizations have all played a role in subsequent reform efforts at state and local levels.[3] Areas of interest include the development of standards, revision of curricula, development of appropriate assessment techniques, and professional development. Several organizations have worked closely with the authors of the National Science Education Standards[4] and published documents to help teachers interpret these standards.[5]

To help policy makers and educators assess the outcomes of their pursuit of excellence in science learning, it is important to find out what American students know and can do in science. The National Assessment of Educational Progress (NAEP) plays a central role in this undertaking. Over the past 27 years, NAEP has administered nine long-term trend assessments to monitor progress in the science performance of 9-, 13-, and 17-year-old students. In addition, the long-term trend assessments included questions about students' experiences related to learning science. These assessments were administered in 1969-70, 1972-73, 1976-77, 1981-82, 1985-86, 1989-90, 1991-92, 1993-94, and 1995-96. The subsequent text refers to each assessment by the last half of the school year in which it was administered: 1969 or 1970, 1973, 1977, 1982, 1986, 1990, 1992, 1994, and 1996. It should be noted that some of the analyses reported in this section do not go back to the first science trend assessment because the data are not available.

1 National Commission on Excellence on Education (1983). *A nation at risk: The imperative for education reform.* Washington, DC.

2 Commission on Precollege Education in Mathematics, Science, and Technology (1983). *Educating Americans for the 21st century: A report to the American people and the National Science Board.* Washington, DC: National Science Board.

3 The National Science Foundation (1995/1996). *Statewide systemic initiatives in science, mathematics, and engineering.* Arlington, VA.

National Science Teachers Association (1995). *Scope, sequence, and coordination of high school science.* Washington, DC.

Project 2061 (1993). *Benchmarks for science literacy.* Washington, DC: American Association for the Advancement of Science.

National Center on Education and the Economy (1993). *New standards project.* Washington, DC.

4 National Research Council (1995). *National science education standards.* Washington, DC.

5 National Science Teachers Association (1995). *A high school framework for national science education standards.* Arlington, VA.

The NAEP Long-Term Trend Science Assessment

In addition to the long-term trend assessment, NAEP conducted a 1996 survey of science achievement among students in grades 4, 8, and 12. To keep abreast of current pedagogical research, this most recent "main" NAEP science assessment included performance tasks such as hands-on investigations and constructed-response questions, as well as multiple-choice questions. Results from the 1996 main NAEP science assessment are presented in a separate report.[6]

Two important features distinguish the long-term trend assessment in science from the main NAEP science assessment: sampling procedures and instrumentation. Data collection for the main NAEP science assessment conducted in 1996 involved national samples of students in grades 4, 8, and 12, and state samples of students in grade 8. In contrast, the long-term trend assessment conducted in 1996 sampled students from across the country at ages 9, 13, and 17. Another important difference between the 1996 main NAEP science assessment and the long-term trend assessment in science was the sets of questions administered. To allow for measuring trends in achievement since the first long-term trend assessment in science, the administration procedures and assessment content were replicated in each trend assessment, including 1996. While the new instrument developed for the 1996 main NAEP assessment placed particular emphasis on constructed-response questions and performance tasks, the long-term trend assessment contains only multiple-choice questions.

Although the main NAEP assessments in each subject area are changed periodically to reflect contemporary educational goals and curriculum content (e.g., the 1996 main NAEP science assessment), the long-term trend science assessment reflects educational objectives that were established in 1969 for 17-year-olds and 1970 for 9- and 13-year-olds. As such, the long-term trend assessment may represent a more constrained view of science in comparison to that of the main science assessment conducted in 1996. The long-term trend assessment in science contains a content dimension and a cognitive dimension.[7] The content dimension assesses life science, physical science, and earth and space science. The cognitive dimension assesses students' ability to conduct inquiries, solve problems, and know science. NAEP also assesses students' understanding of the nature of science within the context of both content area knowledge and cognition. In contrast, the framework for the 1996 main NAEP science assessment specified that students not only be assessed in different areas of science, but also with interdisciplinary exercises that merge technology with the science content areas. Furthermore, the 1996 main assessment included blocks of questions organized around themes that constitute major, interdisciplinary organizing principles of science: models, systems, and patterns of change.[8]

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6 O'Sullivan, C. Y., Reese, C. M., and Mazzeo, J. (1997). *NAEP 1996 science report card for the nation and the states.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

7 National Assessment of Educational Progress (1986). *Science objectives: 1985-1986 assessment.* Princeton, NJ.
National Assessment of Educational Progress (1989). *Science objectives: 1990 assessment.* Princeton, NJ.

8 National Assessment Governing Board (1996). *Science framework for the 1996 National Assessment of Educational Progress.* Washington, DC.

Because of the differences in sampling procedures and assessment content, results from the 1996 main and state NAEP science assessments are not directly comparable to those from the 1996 long-term trend assessment in science. However, results from the trend assessments can provide valuable information about the attainment of long-held educational goals during a time of change and reform. For example, while school curricula shift toward increased emphasis on the application of science knowledge and the ability to communicate scientific concepts, long-term trend results indicate whether students are maintaining their grasp of basic science knowledge and skills. Long-term trend assessments also examine whether current students have greater knowledge of science than did their peers of one and two decades ago.

Analysis Procedures

Estimates of average student performance in the long-term trend assessments were calculated using analysis techniques based on item response theory (IRT). The resultant scale, which spans 0 to 500, allows for comparisons of average scores across assessments, age groups, and demographic subpopulations. (The Procedural Appendix contains more detailed explanations of the analysis procedures and definitions of student subpopulations.) Five different levels of science performance have been defined on the NAEP trend scale:

Level 150 **–** Knows Everyday Science Facts;

Level 200 **–** Understands Simple Scientific Principles;

Level 250 **–** Applies General Scientific Information;

Level 300 **–** Analyzes Scientific Procedures and Data; and

Level 350 **–** Integrates Specialized Scientific Information.

NAEP reports the performance of groups and subgroups of students, not individuals. Two measures of performance are used in this section: the average scores of groups of students on the NAEP science scale, and the percentages of students within each group attaining each of the five performance levels. Because the average scale scores and the percentages are based on samples of students and are subject to sampling and measurement error, standard errors are included with the results presented here.

In the tables and figures that present science trend results, the 1996 assessment was statistically compared to two previous assessments: the prior assessment in 1994, and the first assessment which provided sufficient data on the variables being tested (i.e., the base year). The purpose of year-to-year statistical tests was to determine whether the results in the 1996 assessment were different from the results of the previous assessment or whether any changes had taken place since the base year assessment. Tests of other year-to-year comparisons can be found in previous reports of NAEP long-term trend assessments.

In addition to comparisons between individual assessment years, a second test of significance was conducted to detect statistically significant linear and quadratic trends across assessments. (See the Procedural Appendix for a discussion of the procedure.) This type of analysis makes it possible to discuss statistically significant patterns that may be missed by year-to-year comparisons. For example, from assessment to assessment, students' average scale scores may consistently increase (or decrease) by a small amount. Although these small increases (or decreases) between years may not be statistically significant under pairwise multiple comparisons, the overall increasing (or decreasing) trend in average scores may be statistically significant and noteworthy. The purpose of trend tests is to determine whether the results of the series of assessments could be generally characterized by a line or a simple curve. A linear trend tests for cumulative change over the entire assessment period, such as an increase or decrease at a relatively constant rate. Simple curvilinear (i.e., quadratic) relationships represent more complex patterns. Two examples of such patterns include initial score declines over part of the time period followed by subsequent increases in more recent assessments, or a pattern of initial score increases over a time period followed by a period of relatively stable performance.

This Section

The two chapters in Part I concentrate on different aspects of student performance. Trends in average science scale scores for the nation and demographic subpopulations are reported in Chapter 1. Also included are definitions of levels of science performance and information on the percentages of students attaining successive levels in each assessment. Chapter 2 summarizes trends in students' responses to questions about participation in science activities, course taking, and other student behaviors and attitudes.

In Chapter 1, the results of statistical tests conducted to determine significant differences between 1996 and the first assessment year, and between 1996 and 1994, are indicated in grids that appear next to or below the figures and tables. The results from tests comparing the base year and 1996 assessments are summarized in the column labeled with the asterisk symbol "*." Significant differences are denoted with a "+" or "-" sign indicating that the 1996 average score was either greater than or less than the base year score, respectively. Similarly, significant differences between 1994 and 1996 assessment results are denoted with a "+" or "-" sign under the column labeled with the dagger symbol "‡" indicating that the 1996 average score was either greater or smaller than the 1994 average, respectively. The results from the linear and quadratic trend tests are summarized in the columns labeled "L" and "Q," respectively. Within each column, significant positive trends are denoted by a "+" sign and significant negative trends are denoted with a "-" sign. In Chapter 2, where only the first and most recent assessment results are presented, significant differences between the base year and 1996 are indicated within the tables. All of the differences and trend patterns discussed in this report are statistically significant at the .05 level.

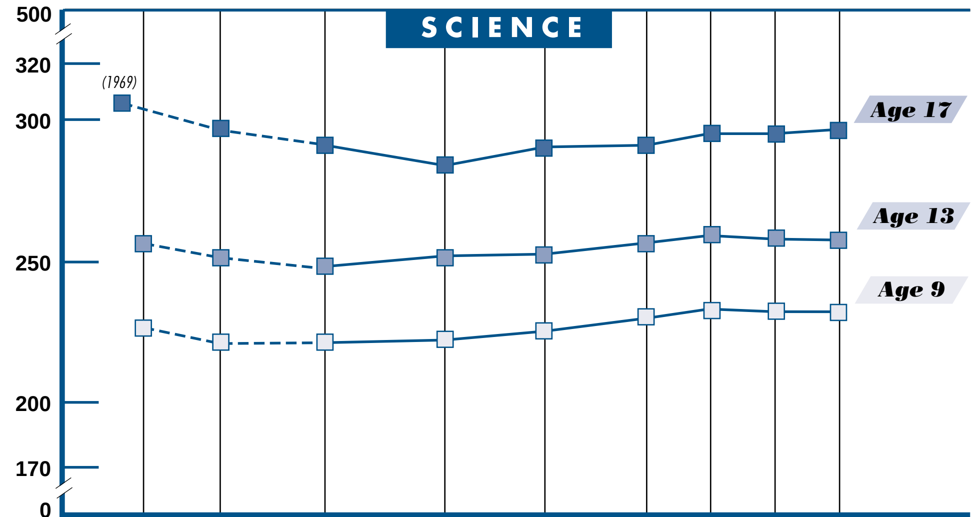
Chapter 1

Science Scores for the Nation and Selected Subpopulations

Results for the Nation from 1969-70 to 1996

Figure 1.1 depicts trends in average science scores for 9-, 13-, and 17-year-old students from 1969 to 1996. The results for 1969 (17-year-olds only), 1970 (9- and 13-year-olds), and 1973 (all age groups) are extrapolated from previous analyses of NAEP data and are represented by dotted lines. Results for the 1977, 1982, 1986, 1990, 1992, 1994, and 1996 assessments are based on more recent analyses and are represented by solid lines. (Refer to the Procedural Appendix for details of scaling methodology and information about drawing inferences from trend analyses.)

Figure 1.1 | **Trends in Average Science Scale Scores for the Nation, 1969-70 to 1996**



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	305 (1.0)	296 (1.0)	290 (1.0)	283 (1.2)	289 (1.4)	290 (1.1)	294 (1.3)	294 (1.6)	296 (1.2)	–		–	+
Age 13	255 (1.1)	250 (1.1)	247 (1.1)	250 (1.3)	251 (1.4)	255 (0.9)	258 (0.8)	257 (1.0)	256 (1.0)			+	+
Age 9	225 (1.2)	220 (1.2)	220 (1.2)	221 (1.8)	224 (1.2)	229 (0.8)	231 (1.0)	231 (1.2)	230 (1.2)	+		+	+

Standard errors of the estimated scale scores appear in parentheses.
[– – –] Extrapolated from previous NAEP analyses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1969-70.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Seventeen-year-olds. The performance of 17-year-old students dropped from 1969 to 1982. Although performance has improved since that time, the overall trend was one of decreased performance. The average score in 1996 was not significantly different from the average in 1994, but was below the 1969 average.

Thirteen-year-olds. The average score of 13-year-olds declined during the 1970s, but has increased since then. Despite an overall pattern of improved performance, the average score in 1996 did not differ significantly from that in 1994 or in 1970.

Nine-year-olds. During the early 1970s, the average science scores of 9-year-olds declined. Since 1982, however, the performance of this age group has improved, and the overall pattern was one of increasing scores. Although there was no significant increase from 1994 to 1996, the average score for 9-year-olds was higher in 1996 than in 1970.

National Trends in Levels of Science Performance from 1977 to 1996

To provide more information about students' knowledge and skills in science, five levels of performance were established on the science trend scale: 150, 200, 250, 300, and 350 (see Procedural Appendix for details).[9] Performance was "anchored" at the five levels by using empirical procedures that identified sets of assessment questions that students who performed at one level were more likely to answer correctly than students who performed at the next lower level. The types of knowledge and skills that these sets of questions assessed were then identified and used as a basis for constructing descriptions of performance at the five scale levels. Figure 1.2 provides these descriptions for the five anchor levels.

Figure 1.2 **Levels of Science Performance**

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Level 350:

Integrates Specialized Scientific Information

Students at this level can infer relationships and draw conclusions using detailed scientific knowledge from the physical sciences, particularly chemistry. They also can apply basic principles of genetics and interpret the social implications of research in this field.

Level 300:

Analyzes Scientific Procedures and Data

Students at this level can evaluate the appropriateness of the design of an experiment. They have more detailed scientific knowledge and the skill to apply their knowledge in interpreting information from text and graphs. These students also exhibit a growing understanding of principles from the physical sciences.

Level 250:

Applies General Scientific Information

Students at this level can interpret data from simple tables and make inferences about the outcomes of experimental procedures. They exhibit knowledge and understanding of the life sciences, including a familiarity with some aspects of animal behavior and of ecological relationships. These students also demonstrate some knowledge of basic information from the physical sciences.

Level 200:

Understands Simple Scientific Principles

Students at this level are developing some understanding of simple scientific principles, particularly in the life sciences. For example, they exhibit some rudimentary knowledge of the structure and function of plants and animals.

Level 150:

Knows Everyday Science Facts

Students at this level know some general scientific facts of the type that could be learned from everyday experiences. They can read simple graphs, match the distinguishing characteristics of animals, and predict the operation of familiar apparatuses that work according to mechanical principles.

[9] In theory, performance levels above 350 and below 150 could have been defined; however, so few students in the assessment performed at the extreme ends of the science scale that it was not practical to do so.

Table 1.1 presents the percentages of students performing at or above the five science performance levels in the seven assessments conducted since 1977.[10] (Performance level data are not available for assessment years with extrapolated results.) The results for each performance level are discussed separately. Data on performance levels by gender, race/ethnicity, modal grade, region, parents' education level, type of school, and quartiles can be found in the Data Appendix.

Table 1.1

Trends in Percentage of Students At or Above Five Science Performance Levels, 1977 to 1996

THE NATION'S REPORT CARD naep

Performance Levels	Age	Assessment Years 1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Level 350 Integrates Specialized Scientific Information	9	0 (0.0)	0 (***)	0 (***)	0 (0.0)	0 (***)	0 (0.0)	0 (0.1)				
	13	1 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.1)	0 (0.2)				
	17	9 (0.4)	7 (0.4)	8 (0.7)	9 (0.5)	10 (0.7)	10 (0.8)	11 (1.0)			+	+
Level 300 Analyzes Scientific Procedures and Data	9	3 (0.3)	2 (0.7)	3 (0.5)	3 (0.3)	3 (0.3)	4 (0.4)	4 (0.4)	+		+	+
	13	11 (0.5)	10 (0.7)	9 (0.9)	11 (0.6)	12 (0.8)	12 (0.9)	12 (0.7)			+	+
	17	42 (0.9)	37 (0.9)	41 (1.4)	43 (1.3)	47 (1.5)	48 (1.3)	48 (1.3)	+		+	+
Level 250 Applies General Scientific Information	9	26 (0.7)	24 (1.8)	28 (1.4)	31 (0.8)	33 (1.0)	34 (1.2)	32 (1.3)	+		+	
	13	49 (1.1)	51 (1.6)	53 (1.6)	57 (1.0)	61 (1.1)	60 (1.1)	58 (1.1)	+		+	
	17	82 (0.7)	77 (1.0)	81 (1.3)	81 (0.9)	83 (1.2)	83 (1.2)	84 (0.9)			+	+
Level 200 Understands Simple Scientific Principles	9	68 (1.1)	71 (1.9)	72 (1.1)	76 (0.9)	78 (1.2)	77 (1.0)	76 (1.2)	+		+	
	13	86 (0.7)	90 (0.8)	92 (1.0)	92 (0.7)	93 (0.5)	92 (0.6)	92 (0.8)	+		+	–
	17	97 (0.2)	96 (0.5)	97 (0.5)	97 (0.3)	98 (0.5)	97 (0.7)	98 (0.3)			+	+
Level 150 Knows Everyday Science Facts	9	94 (0.6)	95 (0.7)	96 (0.3)	97 (0.3)	97 (0.3)	97 (0.4)	97 (0.4)	+		+	–
	13	99 (0.2)	100 (0.1)	100 (0.1)	100 (0.1)	100 (0.1)	100 (0.1)	100 (0.1)	+		+	–
	17	100 (0.0)	100 (0.1)	100 (***)	100 (***)	100 (***)	100 (0.1)	100 (***)				

Standard errors of the estimated percentages appear in parentheses. When no standard error appears (***), standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions. In these cases statistical tests have not been conducted. (See Procedural Appendix.)

* Indicates that the percentage in 1996 is significantly larger (+) or smaller (–) than that in 1977.

‡ Indicates that the percentage in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[10] The performance levels are based upon a vertical scale that assumes knowledge is cumulative. Younger students are not expected to have the same amount of knowledge as older students. Therefore, most 9-year-olds are not expected to reach the upper levels of performance.

Level 350: After a slight decline in the early 1980s, there was an increase in the percentage of 17-year-olds who were able to integrate specialized scientific information, and the overall trend was one of increased percentages. Less than one percent of 9- and 13-year-olds attained this level in 1996.

Level 300: Students' performance at this level was characterized by the ability to analyze scientific procedures and data. For all three age groups, there was evidence of early declines followed by increases in the percentage of students reaching this level. The overall pattern was one of increased percentages of students in each age group attaining at least this level. The percentage of 17-year-old students at this performance level was higher in 1996 than in 1977, but there was no significant difference for the 13-year-olds. Although the difference is small, a significantly higher percentage of 9-year-olds attained this level in 1996 than in 1977.

Level 250: After a decline between 1977 and 1982, the percentage of 17-year-olds able to apply general scientific information increased, and the overall trend was positive. However, the 1996 percentage did not differ significantly from that in 1977. For both 9- and 13-year-olds, the overall trend showed improvement across the assessments, and the 1996 percentage of students at or above this level was higher than the 1977 percentage.

Level 200: In 1996, as in earlier assessment years, most 17-year-olds performed at or above this level, demonstrating understanding of simple scientific principles. The percentage of 13-year-olds reaching this level increased between 1977 and 1986 and has been stable since that time. Among 9-year-olds, an overall pattern of increase was observed in the percentage of students reaching this level. For both 9- and 13-year-olds, the percentage of students at or above this level in 1996 was significantly higher than in 1977.

Level 150: In 1996, nearly all students at all three ages demonstrated knowledge of everyday science facts and an ability to perform tasks at this most basic level. At ages 9 and 13, an increase between 1977 and 1996 was observed in the percentage of students attaining at least this level of performance.

Trends in Science Scale Scores by Quartile from 1977 to 1996

Figure 1.3 depicts the average science scale scores of 9-, 13-, and 17-year-old students who were in the upper quartile (upper 25 percent), middle two quartiles (middle 50 percent), and the lower quartile (lower 25 percent) of student performance in each assessment. As would be expected, standard errors are somewhat smaller for these more homogeneous groups than for the total group. (Please note that these trends are not extrapolated back to 1969 or 1970.)

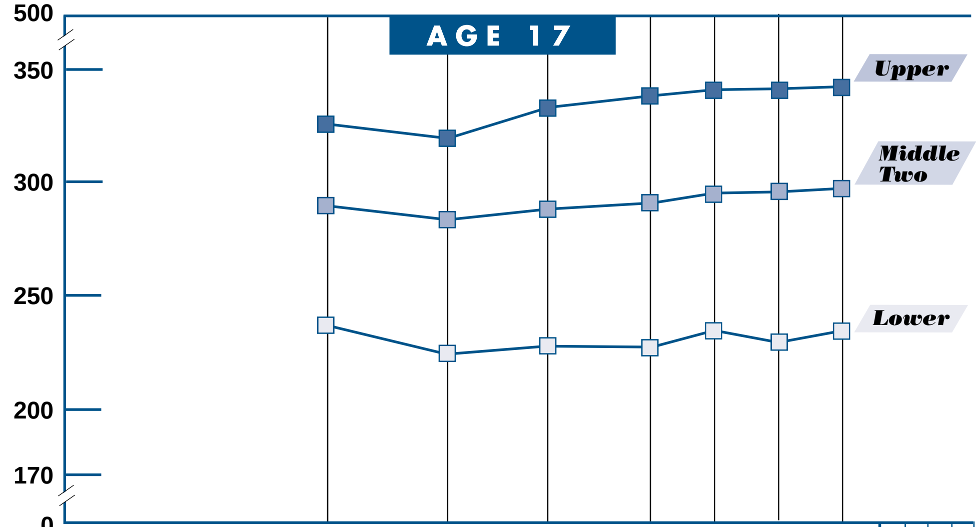
Analyses by quartiles provide information on trends in science scores for students who are at the upper as well as lower points of the distribution of scores. This demonstrates whether overall gains or losses were evident across the full range of performance in science, or whether the results were particular to certain achievement groups. This information is especially relevant in light of one objective of Goal 3 of The National Education Goals, which states that "the academic performance of elementary and secondary students will increase significantly in every quartile . . ."[11], emphasizing that students of all abilities should be granted access to educational opportunities and should demonstrate gains in educational achievement.

For 17-year-olds in the upper quartile, a positive linear trend indicated an overall pattern of increasing scores from 1977 to 1996. For 17-year-olds in the middle two quartiles, average scores decreased between 1977 and 1982 and then increased, resulting in an overall pattern of improved performance. For both quartile groups, average scores in 1996 were higher than those in 1977. The average score of 17-year-olds in the lower quartile declined after the 1977 assessment, and then changed little until 1992 when it recovered slightly. The average score in 1996, however, was not significantly different from that in 1977. Among 13-year-olds in each quartile group, an overall pattern of increasing scores was observed. For students in the lower quartile, an increase in scores from 1977 to 1992 was not sustained in subsequent assessments. In all three performance groups, the average scores for 13-year-olds were higher in 1996 than in 1977. The average scores of 9-year-olds in each performance range showed an overall pattern of increases across the assessment years. For all three quartile groups, average scores in 1996 were significantly higher than scores in 1977.

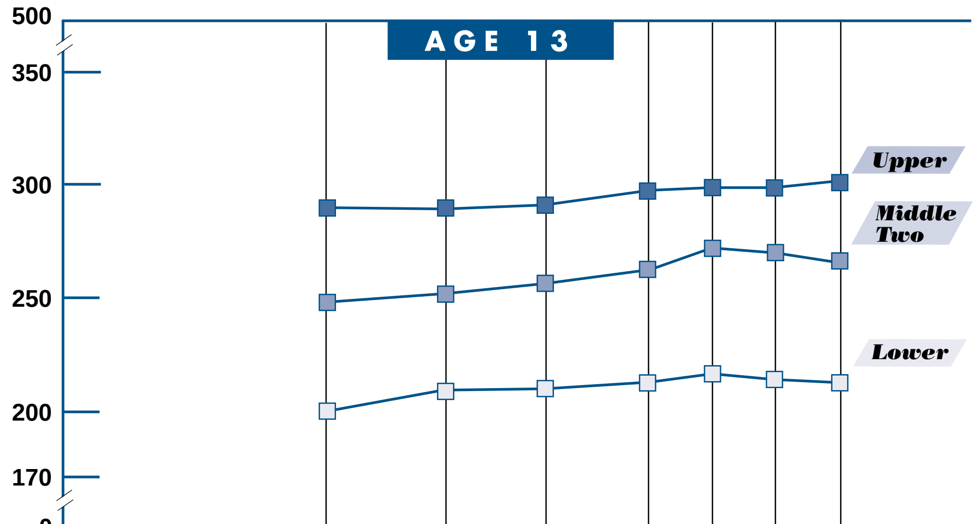
[11] National Education Goals Panel (1996). *The national education goals report: Building a nation of learners.* Washington, DC: U. S. Government Printing Office.

Figure 1.3 — Trends in Average Science Scale Scores by Quartile, 1977 to 1996

THE NATION'S REPORT CARD naep



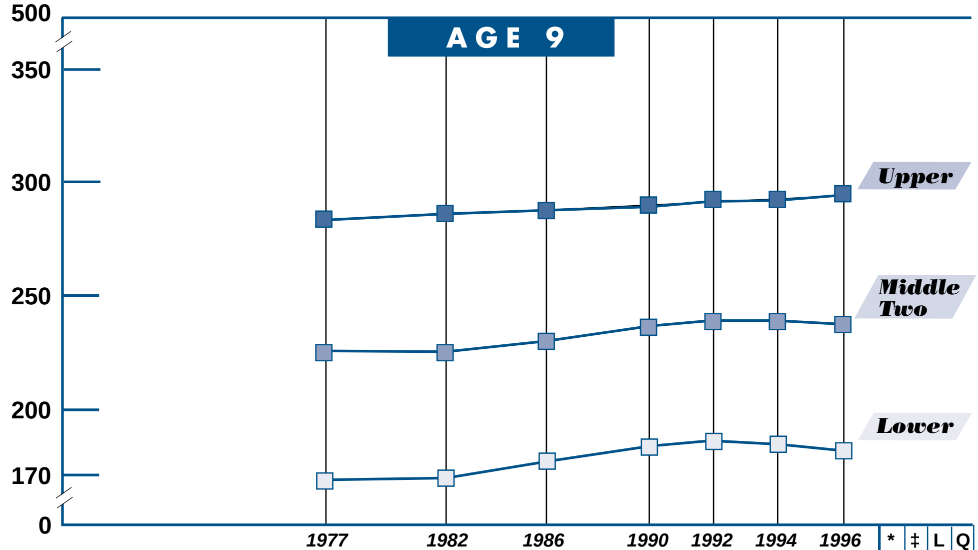
	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	334 (0.9)	329 (1.0)	340 (1.1)	344 (0.7)	346 (0.7)	346 (0.9)	347 (1.7)	+		+	
Middle Two	291 (0.5)	286 (0.7)	290 (0.7)	292 (0.7)	295 (1.0)	296 (0.7)	298 (1.0)	+		+	+
Lower Quartile	242 (0.8)	232 (1.3)	235 (1.3)	234 (1.2)	240 (1.9)	237 (1.7)	240 (1.5)				+



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	291(0.5)	291(0.9)	292(1.1)	297(0.7)	298(1.0)	298(1.2)	299(1.0)	+		+	
Middle Two	249(0.6)	251(0.6)	252(0.7)	256(0.6)	260(0.5)	259(0.7)	257(0.6)	+		+	
Lower Quartile	201(0.8)	208(0.8)	209(0.9)	211(1.2)	214(0.8)	212(1.3)	211(1.0)	+		+	−

Figure 1.3 (continued)

Trends in Average Science Scale Scores by Quartile, 1977 to 1996



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	266(0.9)	268(1.8)	269(1.2)	271(0.8)	273(1.2)	274(1.1)	275(1.1)	+		+	
Middle Two	222(0.5)	222(1.1)	226(0.6)	231(0.5)	233(0.7)	233(1.1)	231(1.1)	+		+	
Lower Quartile	170(1.1)	171(2.0)	177(1.0)	182(0.9)	184(1.2)	183(1.2)	181(1.3)	+		+	

Standard errors of the estimated scale scores appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1977.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Science Scale Scores by Race/Ethnicity from 1969-70 to 1996

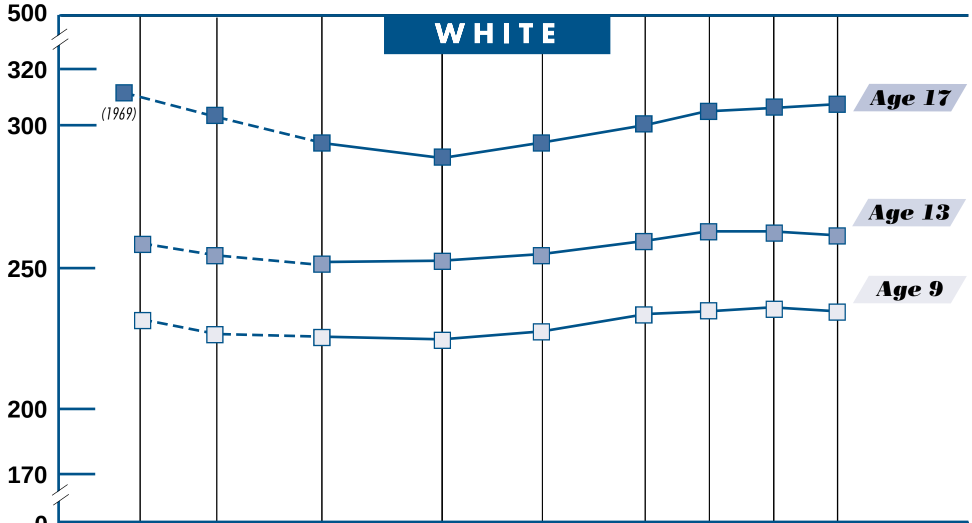
Shown in Figure 1.4 are the trends in average science scale scores for White, Black, and Hispanic students.

White Students. The average scores of White 17-year-olds showed a pattern of decline from 1969 to 1982, followed by a period of improvement. Despite the gains made, the average score for 17-year-olds in 1996 was lower than that in 1969. In general, the overall trends for 9- and 13-year-old White students were characterized by periods of decline during the 1970s followed by recovery periods in the 1980s. Despite the overall pattern of improvement across the assessment years, average scores in 1996 were not significantly different from those in 1970.

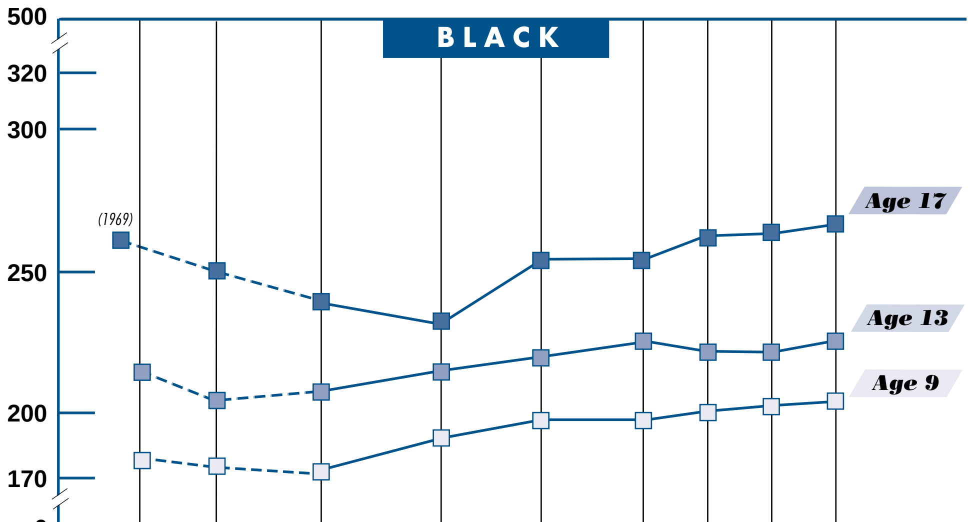
Black Students. Among 17-year-old Black students, a decline in average scores between 1969 and 1982 was followed by an increased performance. Although the overall trend was positive, the average score of these students in 1996 was not significantly different from that of their counterparts in 1969. Despite some fluctuations, the overall trend for Black 9- and 13-year-olds showed a pattern of rising scores between 1970 and 1996. In 1996, the average scores of 9- and 13-year-old students were higher than those in 1970.

Hispanic Students. Despite some fluctuations, the trend for 17-year-olds indicated overall improvement across the assessment years. Nevertheless, no significant difference was found between the 1977 and 1996 average scores of Hispanic 17-year-olds. An overall pattern of improved performance was found for Hispanic 9- and 13-year-old students. (Note that science scale scores were not extrapolated back to 1970 for Hispanic students.) For both age groups, the 1996 average score was higher than the average score in 1977.

Figure 1.4 Trends in Average Science Scale Scores by Race/Ethnicity, 1969-70 to 1996



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	312(0.8) –	304(0.8) –	298(0.7) 83(1.3)	293(1.0) 81(2.0)	298(1.7) 78(0.5)	301(1.1) 73(0.5)	304(1.3) 75(0.5)	306(1.5) 72(0.6)	307(1.2) 71(0.7)	–			+
Age 13	263(0.8) –	259(0.8) –	256(0.8) 80(1.6)	257(1.1) 79(2.1)	259(1.4) 77(1.0)	264(0.9) 73(0.7)	267(1.0) 74(0.5)	267(1.0) 72(0.8)	266(1.1) 71(0.6)			+	+
Age 9	236(0.9) –	231(0.9) –	230(0.9) 80(1.6)	229(1.9) 79(2.6)	232(1.2) 77(1.1)	238(0.8) 75(1.1)	239(1.0) 75(0.9)	240(1.3) 74(0.9)	239(1.4) 71(1.1)			+	+

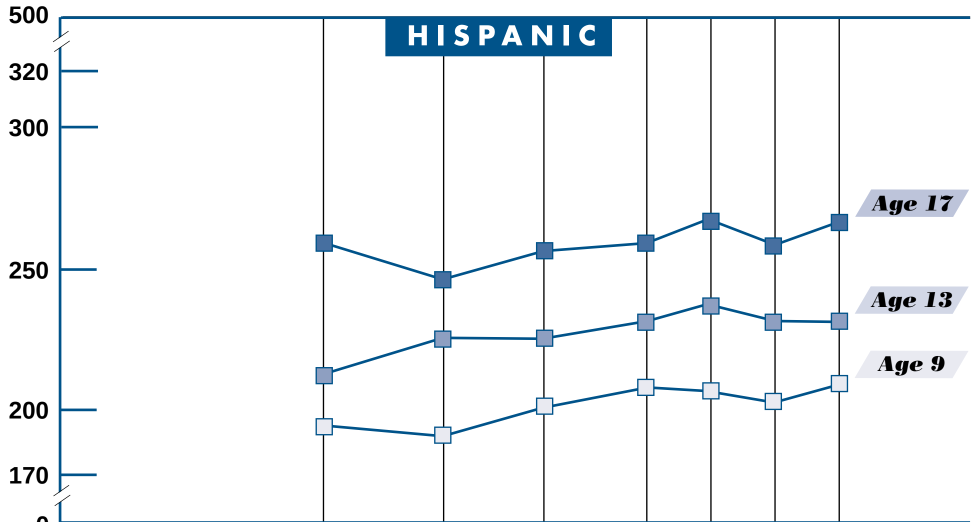


	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	258(1.5) –	250(1.5) –	240(1.5) 12(1.1)	235(1.7) 13(1.4)	253(2.9) 14(0.3)	253(4.5) 16(0.3)	256(3.2) 15(0.3)	257(3.1) 15(0.3)	260(2.4) 15(0.3)			+	+
Age 13	215(2.4) –	205(2.4) –	208(2.4) 13(1.2)	217(1.3) 14(1.9)	222(2.5) 14(0.9)	226(3.1) 16(0.3)	224(2.7) 16(0.3)	224(4.2) 15(0.3)	226(2.1) 15(0.4)	+		+	
Age 9	179(1.9) –	177(1.9) –	175(1.8) 14(1.4)	187(3.0) 14(2.1)	196(1.9) 15(0.5)	196(2.0) 16(0.7)	200(2.7) 16(0.4)	201(1.7) 15(0.5)	202(3.0) 16(0.5)	+		+	

Figure 1.4 (continued)

Trends in Average Science Scale Scores by Race/Ethnicity, 1969-70 to 1996

THE NATION'S REPORT CARD naep



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	262(2.2) 4(0.9)	249(2.3) 5(1.1)	259(3.8) 6(0.3)	262(4.4) 7(0.4)	270(5.6) 7(0.5)	261(6.7) 9(0.3)	269(3.3) 9(0.7)			+	
Age 13	213(1.9) 5(1.1)	226(3.9) 5(1.0)	226(3.1) 7(1.1)	232(2.6) 7(0.5)	238(2.6) 7(0.5)	232(2.4) 8(0.4)	232(2.5) 9(0.7)	+		+	
Age 9	192(2.7) 5(0.9)	189(4.2) 5(1.3)	199(3.1) 6(1.1)	206(2.2) 6(0.6)	205(2.8) 6(0.8)	201(2.7) 6(0.4)	207(2.8) 8(1.0)	+		+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

[– – –] Extrapolated from previous NAEP analyses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1969-70 (for White and Black students) or in 1977 (for Hispanic students).

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

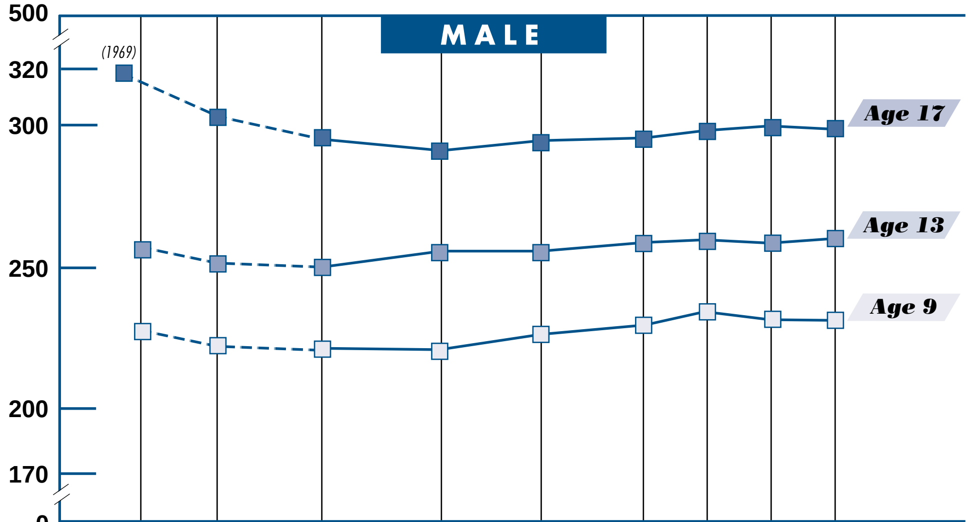
Trends in Science Scale Scores by Gender from 1969-70 to 1996

Figure 1.5 shows trends in average science scale scores for male and female students at all three ages.

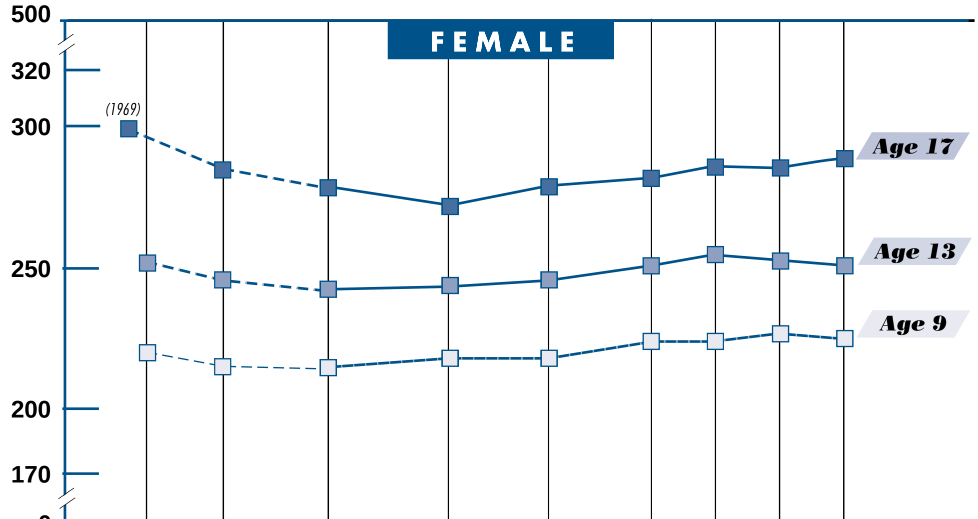
Male Students. Among 17-year-old males, average science scores declined between 1969 and 1982. Although gains have been made since that time, the overall trend was one of decreased performance and the 1996 average score was lower than the 1969 average. Despite an initial period of decline in the 1970s, the performance of 9- and 13-year-old males improved over the assessment years. However, average science scores in 1996 did not differ significantly from those in 1970.

Female Students. From 1969 until 1982, science scores for 17-year-old females declined, then subsequently rose. As with 17-year-old males, however, the 1996 average score for females was still below the average of 27 years earlier. For 9- and 13-year-old female students, trend analyses revealed an overall pattern of improved performance. Among 13-year-olds, declining performance during the 1970s was followed by a recovery period in the 1980s. For 9-year-olds the overall pattern is similar, except that the gains made during the 1980s resulted in an average score in 1996 that was higher than the average in 1970.

Figure 1.5 — Trends in Average Science Scale Scores by Gender, 1969-70 to 1996



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	314(1.2) —	304(1.2) —	297(1.2) 50(0.7)	292(1.4) 48(0.7)	295(1.9) 49(1.2)	296(1.3) 49(0.9)	299(1.7) 51(1.2)	300(2.0) 49(1.3)	300(1.6) 50(1.2)	–		–	+
Age 13	257(1.3) —	252(1.3) —	251(1.3) 50(0.3)	256(1.5) 49(0.7)	256(1.6) 50(0.9)	259(1.1) 50(0.6)	260(1.2) 50(0.8)	259(1.2) 49(0.8)	260(1.0) 48(0.8)			+	+
Age 9	228(1.3) —	223(1.3) —	222(1.3) 51(0.4)	221(2.3) 51(0.5)	227(1.4) 50(0.6)	230(1.1) 49(0.6)	235(1.2) 49(0.6)	232(1.3) 49(0.8)	231(1.7) 50(0.6)			+	+



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	297(1.1) —	288(1.1) —	282(1.1) 51(0.7)	275(1.3) 52(0.7)	282(1.5) 51(1.2)	285(1.6) 51(0.9)	289(1.5) 49(1.2)	289(1.7) 50(1.3)	292(1.4) 50(1.2)	–			+
Age 13	253(1.2) —	247(1.2) —	244(1.2) 50(0.3)	245(1.3) 52(0.7)	247(1.5) 50(0.9)	252(1.1) 50(0.6)	256(1.0) 50(0.8)	254(1.2) 51(0.8)	252(1.3) 52(0.8)			+	+
Age 9	223(1.2) —	218(1.2) —	218(1.2) 49(0.4)	221(2.0) 50(1.5)	221(1.4) 50(0.6)	227(1.0) 51(0.6)	227(1.0) 51(0.6)	230(1.4) 51(0.8)	228(1.5) 50(0.6)	+		+	+

Below each average scale score, the corresponding percentage of students is presented.
Standard errors of the estimated scale scores and percentages appear in parentheses.
[– – –] Extrapolated from previous NAEP analyses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1969-70.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Differences in Average Science Scale Scores by Race/Ethnicity and by Gender

The previous sections discussed trends in science achievement for students of different racial/ethnic and gender groups. NAEP studies, as well as other academic assessments, have commonly found higher average achievement in science for White students compared to their minority peer groups, and for males compared to females.[12] The size of the performance gaps between the groups, and the trends in these differences, are matters of considerable interest. Trends in score differences help shed light on whether the gaps between racial/ethnic and between gender groups are increasing, decreasing, or staying the same over time. As with past NAEP assessments, significant performance differences were observed in the 1996 trend assessment among racial/ethnic subgroups and between males and females. Trends in the differences between the average science scores of selected subgroups of students are displayed in Figure 1.6.

A number of factors should be considered when interpreting achievement differences between subgroups. For example, some research has suggested that many minority students attend schools that limit their "opportunity to learn" by providing substandard physical facilities, fewer academic resources, and less challenging curricula.[13] Others have argued that disproportionate numbers of minority students are placed in low-ability classes that provide them with less intensive curricula.[14] Furthermore, some research points to discrepancies in background characteristics, such as socioeconomic status and home resources, as well as supportive learning environments, to explain differences between the academic achievement of racial/ethnic subgroups.[15] Gender differences in science performance may be related to

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12 Campbell, J. R., Reese, C. M., O'Sullivan, C., & Dossey, J. A. (1996). *NAEP 1994 trends in academic progress.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

Jones, L. R., Mullis, I. V. S., Raizen, S. A., Weiss, I. R., & Weston, E. A. (1992). *The 1990 science report card: NAEP's assessment of fourth, eighth, and twelfth graders.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

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13 Fine, M. (1991). Framing dropouts. Albany, NY: State University of New York Press.

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Stevens, F. (1993). *Opportunity to learn: Issues of equity for poor and minority students.* Washington, DC: National Center for Education Statistics.

14 King, S.H. (1993). The limited presence of African-American teachers. Review of Educational Research, 63, 115-149.

Meier, K. J., Stewart, J. Jr., & England, R. E. (1989). *Race, class, and education: The politics of second generation discrimination.* Madison, WI: The University of Wisconsin Press.

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15 Peng. S. (1995). *Understanding racial-ethnic differences in secondary science and mathematics achievement.* National Science Foundation. Washington, DC: National Center for Education Statistics.

different course-taking patterns and less favorable attitudes toward science among females.[16] Other research has found that many parents and teachers hold lower expectations for females' success in science classes, and that females are given less encouragement to enroll in advanced science courses, are not called on as frequently in science class, and have fewer female role models.[17]

These factors are consistent with other research that has used NAEP results to explore differences in performance between racial groups.[18] Recent arguments demonstrate that reporting unadjusted differences among racial groups may be misleading since these groups come from different family, school, and community contexts that are related to achievement. When achievement results are controlled for social context, test score differences between groups may be reduced.[19] Other research shows that while a substantial performance gap still exists, the performance difference between non-Hispanic White 13- and 17-year-olds and their Hispanic and Black peers has narrowed between 1975 and 1990. Gains among Black and Hispanic students, however, could not be explained by changing family characteristics (parental education level, family size, family income) alone.[20]

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16 Jones, L. R., Mullis, I. V. S., Raizen, S. A., Weiss, I. R., & Weston, E. A. (1992). *The 1990 science report card: NAEP's assessment of fourth, eighth, and twelfth graders.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

17 Kahle, J. B., & Lakes, M. K. (1983). The myth of equality in science classrooms. *Journal of Research in Science Teaching, 20,* 131-140.

Linn, M. C., & Hyde, J. S. (1989). Gender, mathematics, and science, *Educational Researcher, 18(8),* 17-27.

Oakes, J. (1990). Opportunities, achievement, and choice: Women and minority students in science and mathematics. *Review of Research in Education, 16.*

18 Berends, M., & Koretz, D. M. (1995). Reporting minority students' test scores: How well can the National Assessment of Educational Progress account for differences in social context? *Educational Assessment, 3(3),* 249-285.

Jaynes, G. D., & Williams, R. M. Jr. (Eds.), (1989). *A common destiny: Blacks and American society.* National Academy Press: Washington, DC.

Grissmer, D.W., Kirby, S. N., Berends, M., & Williamson, S. (1994). *Student achievement and the changing American family.* Santa Monica, CA: Rand.

19 Berends, M., & Koretz, D. M. (1995). op. cit.

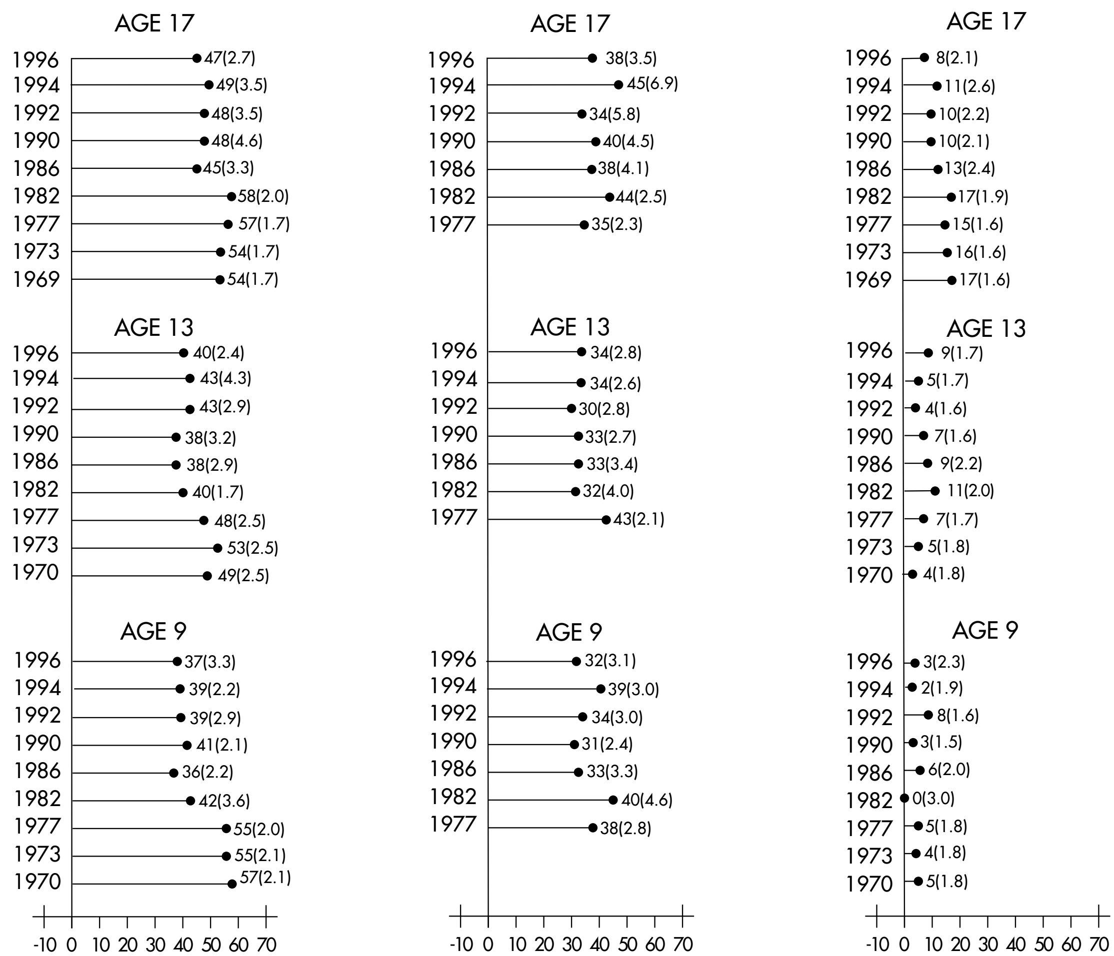
20 Grissmer, D.W., Kirby, S. N., Berends, M., & Williamson, S. op. cit.

Figure 1.6 Trends in Differences in Average Science Scale Scores by Race/Ethnicity and Gender

White vs. Black Students (White Minus Black)

White vs. Hispanic Students (White Minus Hispanic)

Male vs. Female Students (Male Minus Female)



White vs. Black Students:

	*	‡	L	Q
Age 17	–		–	
Age 13	–		–	+
Age 9	–		–	+

White vs. Hispanic Students:

	*	‡	L	Q
Age 17				
Age 13	–			
Age 9				

Male vs. Female Students:

	*	‡	L	Q
Age 17	–		–	
Age 13				–
Age 9				

Standard errors of the estimated scale score differences appear in parentheses.

* Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1969-70 (for White vs. Black student and Male vs. Female student differences) or from 1977 (for White vs. Hispanic student differences).

‡ Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

White-Black. In 1996, at all three age groups, White students outperformed Black students. Trend analyses revealed a narrowing gap between White and Black students' average science scores across the assessment years for each age group. For 17-year-olds, this narrowing was largely due to an 18-point gain by Black students between 1982 and 1986, compared to a 5-point gain by White students during the same time period. The 1969 and 1996 scale score gaps are significantly different. However, there has been little change in the size of the White-Black gap between 1986 and 1996. The score gap between White and Black 13-year-old students declined between 1970 and 1986, and changed little during the 1990s. As a result, the 1996 score difference was smaller than the 1970 difference. Again, this decline was due to an increase in Black students' scores from 1973 to 1986, while White students' scores remained relatively stable. Among 9-year-olds, the trend in score differences is similar. The gap in scores between White and Black students declined between 1970 and 1986, and changed little since that time. The size of the gap was smaller in 1996 than in 1970. The reason for the gap reduction for 9-year-olds was improved performance among Black students between 1977 and 1986, while White students' performance changed little during this time.

White-Hispanic. In 1996, at all three ages, White students outperformed Hispanic students. For both 9- and 17-year-old students, trend analyses across the assessment years 1977 to 1996 revealed no overall change in the average score gaps between White and Hispanic students. Direct comparisons of the 1977 and 1996 score gaps showed no statistically significant difference for either age group. Among 13-year-olds, there was some evidence that the difference in average scale scores between White and Hispanic students decreased between 1977 and 1982, but the gap has changed little since that time. The gap in scores between White and Hispanic students remains smaller in 1996 than in 1977.

Male-Female. In 1996, male 13- and 17-year-olds had higher average science scores than did their female peers. The difference in average scores between 17-year-old male and female students declined over the assessment years due primarily to a decrease that occurred after 1982. This reduction in the gap resulted from a 14-point gain for female students between 1982 and 1992, while scores for males increased by 7 points during that same time period. The difference between males and females in 1996 was smaller than the difference in 1969. Among 13-year-olds, trend analyses across the assessment years 1970 to 1996 showed evidence of a widening gap between males and females from 1970 to 1982. The gap then narrowed somewhat until 1992, but appears to have widened again in the last two assessments. The score gap in 1996 did not differ significantly from that in 1970. Despite some fluctuation among 9-year-olds across the assessments, there was no significant change in the magnitude of the differences between male and female students' average scores.

Trends in Science Scale Scores by Region from 1969-70 to 1996

Given the diversity among school districts across the United States, it is interesting to explore trends within separate regions of the country. These data reveal the changes that have occurred in the last 27 years for students in different areas of the country — Northeast, Southeast, Central, and West — and demonstrate whether overall performance gains or losses in science were similar for different geographic regions. Figure 1.7 depicts trends in average science scale scores by region.

Northeast. For 17-year-olds in the Northeast, science scores decreased between 1969 and 1982, but have since increased. Despite these gains, the average score in 1996 was still below the average in 1969. For 13-year-olds, there were no significant changes between 1970 and 1996. However, the average score in 1996 was lower than in 1994. Nine-year-olds showed early declines followed by subsequent gains in science performance. Although the overall trend is positive, the 1996 average score did not differ significantly from the 1970 average score.

Southeast. The average score of 17-year-olds in the Southeast decreased in the 1970s. Despite subsequent gains, the average score in 1996 did not differ significantly from the average in 1969. For 9- and 13-year-old students, an overall pattern of increased performance was observed. For both age groups, average scores in 1996 were higher than those in 1970.

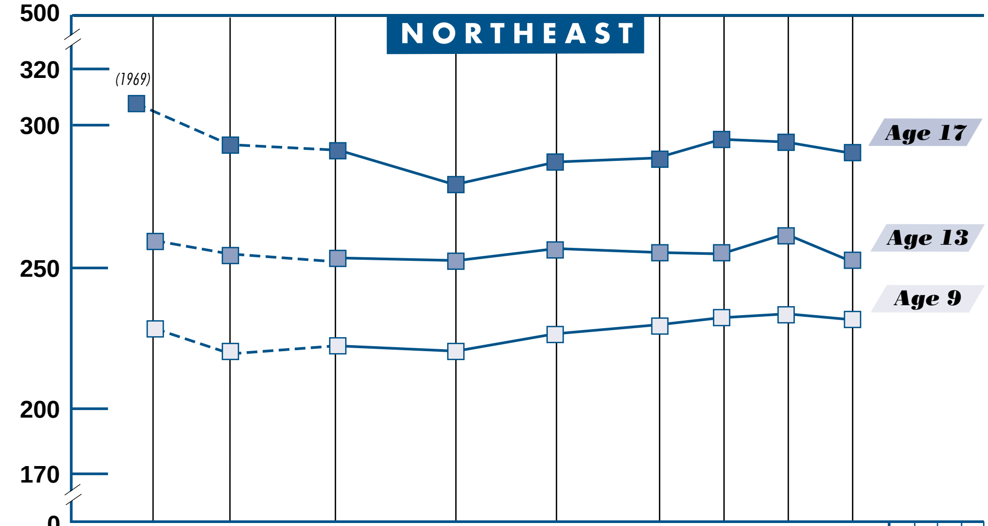
Central. Among 17-year-olds in the Central region, the average science score declined from 1969 to 1982, but has since increased. The 1996 average score was not significantly different from that in 1969; further, although the observed 1996 average was about 10 points higher than the observed 1994 average, this difference was not statistically significant. For 13-year-olds, science scores decreased from 1970 to 1986, then increased. For 9-year-olds, science scores declined in the 1970s, then increased. For both 9- and 13-year-olds, the trend analyses revealed an overall pattern of improvements; however, the average scores for both age groups in 1996 were not significantly different from those in 1970.

West. Decreasing scores were observed for 17-year-olds in the West from 1969 to 1982, followed by increasing scores in the 1980s. However, the overall trend was one of decreasing performance and the 1996 average score for these students continued to be lower than the average score of their counterparts in 1969. The overall pattern of performance for 9- and 13-year-olds was one of improved performance. Despite small gains across the assessment years, the 1970 and 1996 average scores did not differ significantly for either age group.

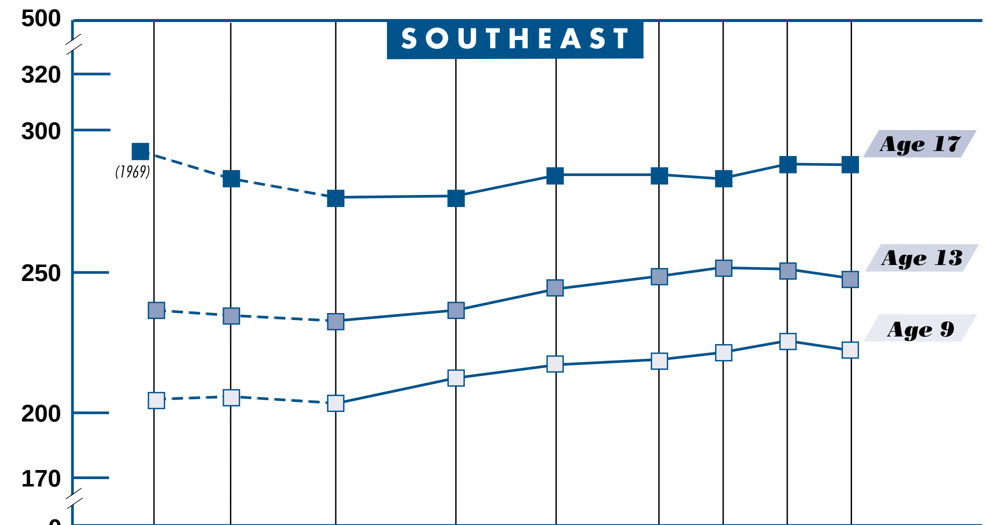
A comparison of the 1996 average scores of students from different regions revealed that, for both 13- and 17-year-olds, students in the Central region outperformed their peers in the Southeast and West. Thirteen-year-olds in the Central region also had higher average scores than students in the Northeast. No regional differences were observed for 9-year-olds.

Figure 1.7

Trends in Average Science Scale Scores by Region, 1969-70 to 1996



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	308(2.5) –	298(2.5) –	296(2.2) 24(1.7)	284((2.0) 25(3.0)	292(4.3) 24(0.8)	293(3.2) 22(1.0)	300(2.4) 22(0.9)	299(4.2) 23(1.0)	296(3.3) 23(2.7)	–			+
Age 13	261(2.2) –	256(2.2) –	255(2.3) 26(1.5)	254(2.1) 24(2.9)	258(3.1) 22(1.6)	257(2.7) 24(1.0)	257(2.2) 21(0.8)	263(1.7) 20(0.9)	255(3.0) 22(2.0)		–		
Age 9	230(2.9) –	222(2.9) —	224(1.6) 25(1.5)	222(2.9) 19(2.3)	228(3.5) 21(1.1)	231(2.4) 23(0.9)	234(2.8) 21(1.2)	235(2.5) 22(0.9)	234(2.6) 22(2.3)			+	+



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	287(2.3) –	283(2.3) —	276(1.9) 18(1.0)	276(2.7) 21(2.4)	284(2.0) 23(2.3)	284(2.4) 24(0.9)	283(2.5) 25(1.4)	288(2.8) 25(1.5)	288(3.1) 22(2.9)				+
Age 13	239(2.4) –	237(2.4) —	235(1.8) 21(1.1)	239(2.3) 22(2.3)	247(2.2) 25(5.8)	251(1.9) 23(0.8)	254(2.8) 24(1.6)	253(2.6) 22(1.7)	251(2.7) 25(2.6)	+		+	
Age 9	206(1.6) –	207(1.6) —	205(2.9) 20(1.2)	214(3.6) 23(2.7)	219(3.1) 23(4.7)	220(1.9) 24(0.9)	223(1.7) 24(1.3)	227(2.2) 25(1.5)	224(3.4) 23(2.6)	+		+	

Figure 1.7 (continued)

Trends in Average Science Scale Scores by Region, 1969-70 to 1996

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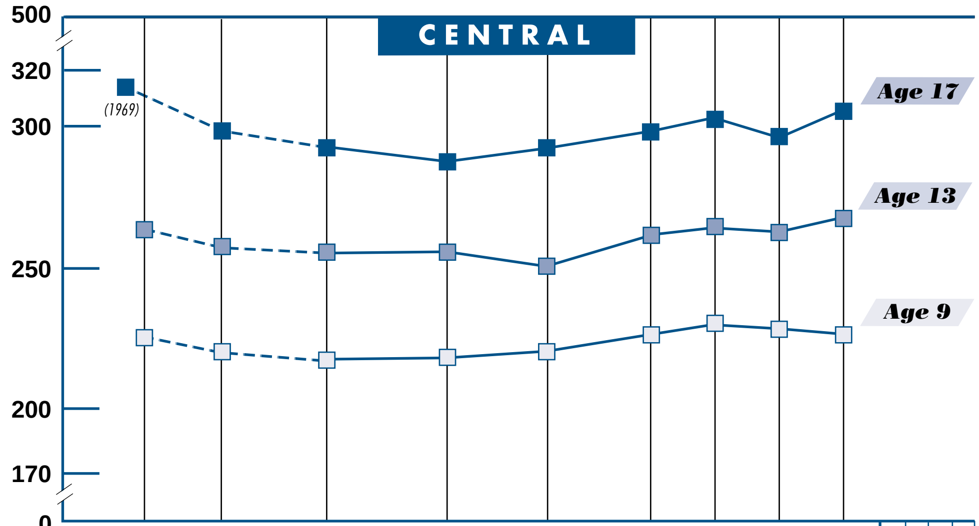
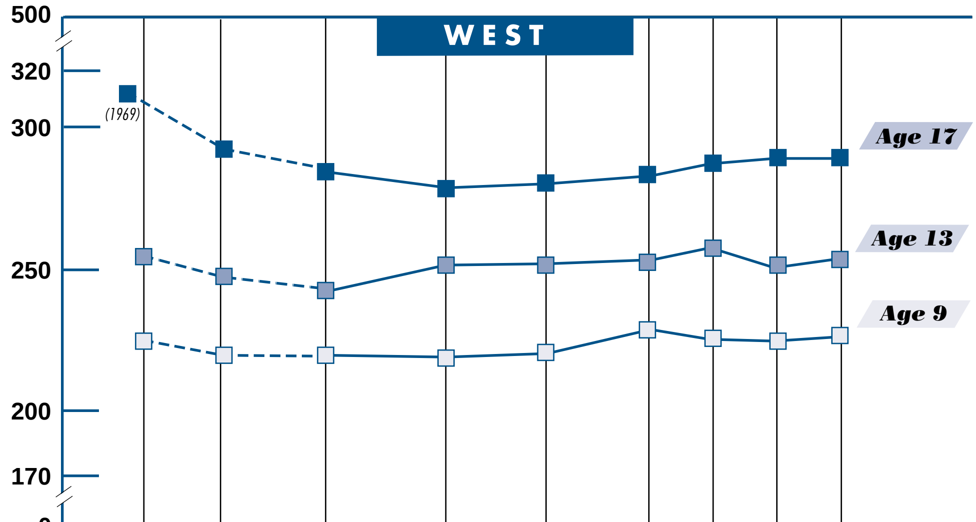


	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	308(1.9) —	300(1.9) —	294(1.5) 33(1.6)	289(2.6) 30(3.9)	294(2.3) 28(2.2)	300(3.0) 26(0.9)	304(2.7) 25(1.0)	298(3.7) 26(1.1)	307(2.6) 25(0.9)				+
Age 13	262(1.8) —	256(1.8) —	254(1.8) 27(1.9)	254(2.6) 28(3.9)	249(5.3) 25(5.0)	260(2.8) 24(0.7)	263(2.1) 27(1.0)	261(3.5) 27(1.8)	266(1.8) 23(1.0)			+	+
Age 9	233(3.0) —	228(3.0) —	225(2.2) 30(1.9)	226(3.5) 30(4.3)	228(2.2) 29(4.0)	234(1.7) 24(0.6)	238(1.8) 28(0.8)	236(2.7) 26(1.0)	234(2.4) 25(0.9)			+	+



	1970	1973	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	308(1.7) —	295(1.7) —	287(1.5) 24(1.9)	281(2.7) 25(2.6)	283(3.8) 26(0.9)	286(2.3) 28(0.9)	290(3.8) 29(0.9)	292(4.1) 27(1.0)	292(2.4) 30(2.3)	–		–	+
Age 13	255(1.8) —	248(1.8) —	243(2.3) 26(2.1)	252(2.8) 26(2.5)	252(2.7) 28(1.5)	253(2.1) 29(0.9)	258(1.6) 29(0.9)	252(2.1) 31(1.1)	254(1.8) 30(1.9)			+	
Age 9	226(2.2) —	221(2.2) —	221(2.2) 25(2.0)	220(4.1) 28(2.7)	222(3.2) 28(1.6)	230(1.8) 28(0.8)	227(2.2) 27(0.8)	226(2.7) 28(1.0)	228(1.9) 30(2.6)			+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

[– – –] Extrapolated from previous NAEP analyses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1969-70.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Science Scale Scores by Parents' Highest Level of Education from 1977 to 1996

A consistent predictor of students' achievement is the education level of their parents.[21] In general, students with less-educated parents tend to have lower academic scores than students whose parents have higher levels of educational attainment. Similarly, adults whose parents completed more years of education typically have more advanced literacy skills than those whose parents have fewer years of education.[22]

Figure 1.8 presents trends in average science scores by parents' highest level of education. When one compares the 1996 average science scores for groups of students with different levels of parental education, the results generally reveal higher average science scores for students with higher levels of parental education. This pattern was consistent for all age groups with only two exceptions among 9-year-olds: no significant performance differences were found between students with parents whose highest education level was high school graduation and those whose parents did not graduate from high school, or between students with parents who had graduated from college and those whose parents' highest education level was some education beyond high school.

The percentage of students in each age group who reported that one or both parents had graduated from college increased from 1977 to 1996. Conversely, the percentage of students who reported their parent(s) had less than a high school diploma decreased during this time period for all three age groups. It should be noted that across the trend assessments, approximately one-third of 9-year-olds and one-tenth of 13-year-olds responded "I don't know" to the question about their parents' highest level of education. Furthermore, some research has revealed the potential for young children to provide inaccurate reports about such information.[23]

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[21] National Center for Education Statistics (1990). *A profile of the American eighth grader: NELS:88 student descriptive summary* (NCES 90-458). Washington, DC: U.S. Government Printing Office.

Jones, L. R., Mullis, I. V. S., Raizen, S. A., Weiss, I. R., & Weston, E. A. (1992). *The 1990 science report card: NAEP's assessment of fourth, eighth, and twelfth graders.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

[22] Kirsch, I. S., Jungeblut, A., Jenkins, L., & Kolstad, A. (1993). *Adult literacy in America: A first look at the results of the National Adult Literacy Survey.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

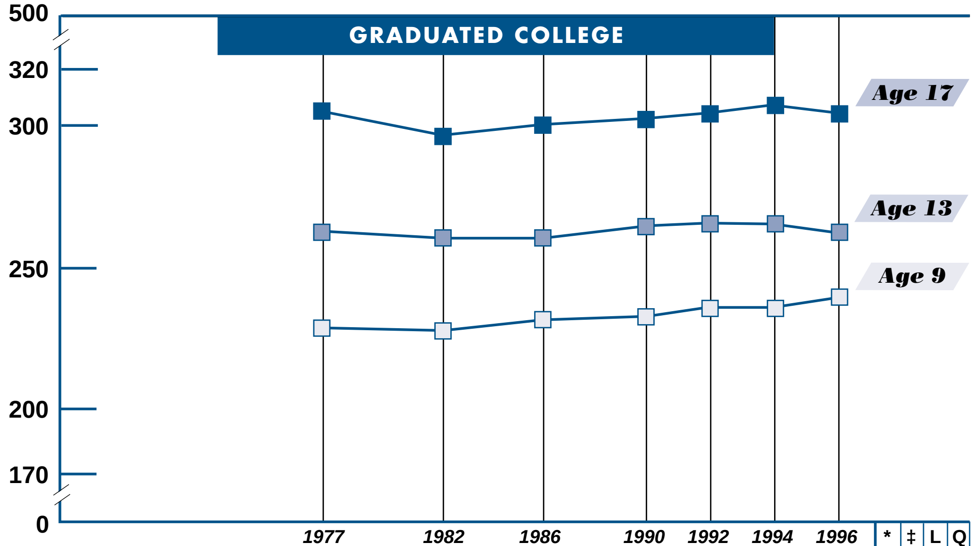
[23] Looker, E. D. (1989). Accuracy of proxy reports of parental status characteristics. *Sociology of Education, 62*(4), 257-276.

For 17-year-olds with at least one college-educated parent, a decline in science scores between 1977 and 1982 was followed by a period of increases. The average score of 17-year-old students who reported high school graduation as their parents' highest level of education also declined between 1977 and 1982 and has increased since that time. However, the average score for both groups of students in 1996 was not significantly different from the average score in 1977. No overall trends in average scores were observed for 17-year-olds whose parents had not graduated from high school or had some education after high school.

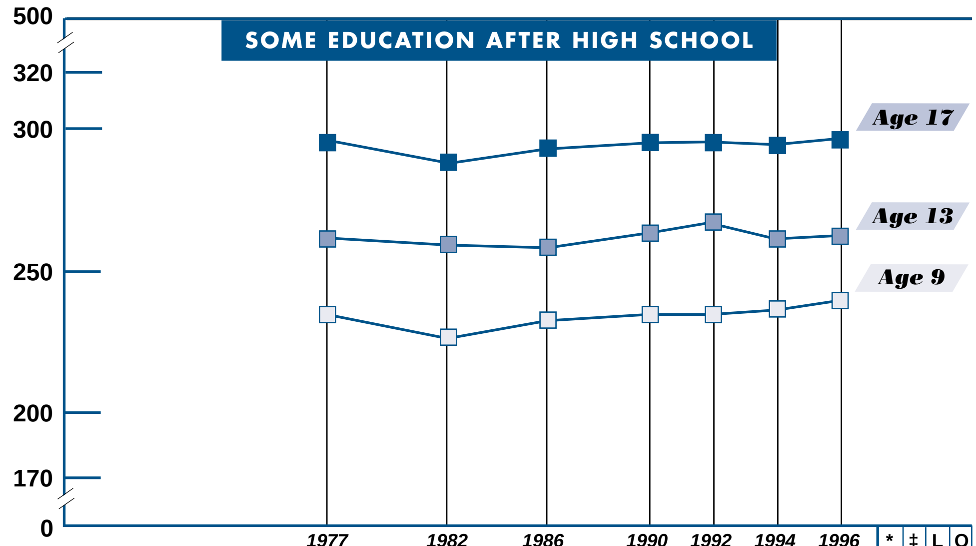
Among 13-year-olds whose parents had not graduated from high school, an overall pattern of increasing scores was observed across the assessment years. However, the average score in 1996 did not differ significantly from that in 1977. The performance of 13-year-olds at other levels of parental education showed no significant linear or quadratic trend over the assessment years.

The average science scores for 9-year-olds who reported that at least one parent graduated from college followed an increasing trend across the assessment years, resulting in a higher average score in 1996 compared to that in 1977. A similar trend was observed for 9-year-olds who reported that neither parent had graduated from high school. No overall trends in average scores were observed for 9-year-olds whose parents' highest level of education was either a high school diploma or some education after high school.

Figure 1.8 Trends in Average Science Scale Scores by Parents' Highest Level of Education, 1977 to 1996



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	309(1.0) 30(1.2)	300(1.7) 32(1.4)	304(2.1) 37(1.2)	306(1.7) 39(1.4)	308(1.3) 43(1.4)	311(1.6) 44(1.5)	308(1.5) 46(1.5)				+
Age 13	266(1.0) 27(1.0)	264(1.5) 37(1.5)	264(1.9) 38(2.0)	268(1.1) 41(1.2)	269(1.0) 44(1.3)	269(1.3) 46(1.3)	266(1.2) 45(1.6)				
Age 9	232(1.4) 23(0.7)	231(2.3) 42(2.3)	235(1.4) 38(1.1)	236(1.3) 40(1.1)	239(1.2) 42(1.2)	239(1.4) 45(0.8)	240(1.6) 43(1.2)	+		+	



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	296(1.1) 17(0.4)	290(1.7) 22(0.6)	295(2.5) 24(1.0)	297(1.6) 24(0.9)	296(1.7) 25(0.9)	295(1.9) 24(1.1)	297(1.9) 24(1.1)				
Age 13	260(1.3) 15(0.5)	259(1.5) 17(0.6)	258(1.4) 16(0.6)	263(1.2) 17(0.6)	266(1.1) 18(0.7)	260(2.0) 17(0.6)	261(1.4) 17(0.5)				
Age 9	237(1.5) 7(0.3)	229(3.2) 8(0.6)	236(2.6) 7(0.6)	238(2.1) 7(0.4)	237(2.4) 8(0.4)	239(2.8) 7(0.4)	242(2.9) 7(0.4)				

Figure 1.8 (continued)

Trends in Average Science Scale Scores by Parents' Highest Level of Education, 1977 to 1996

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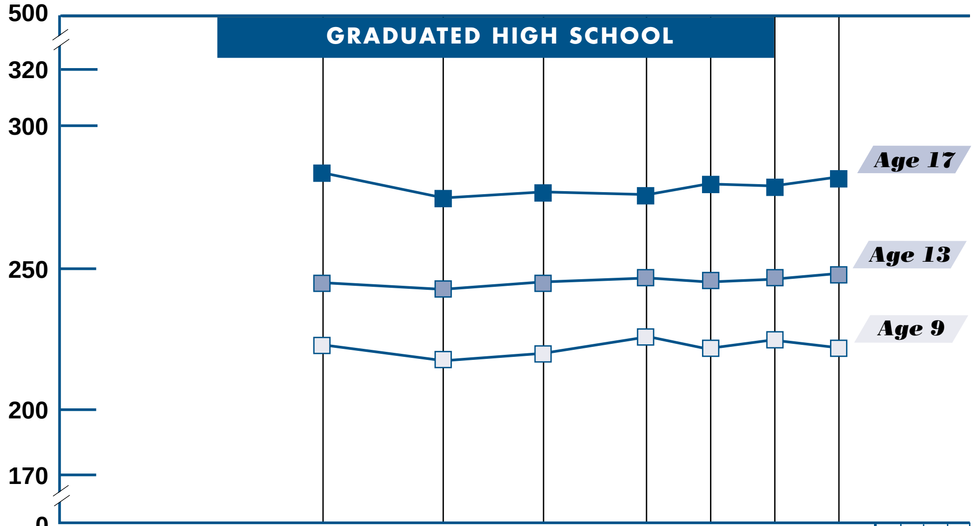
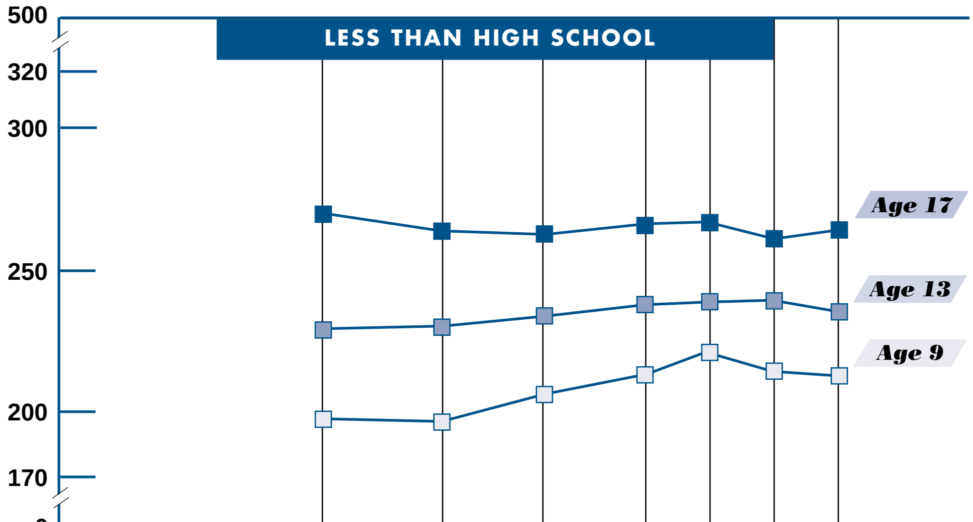


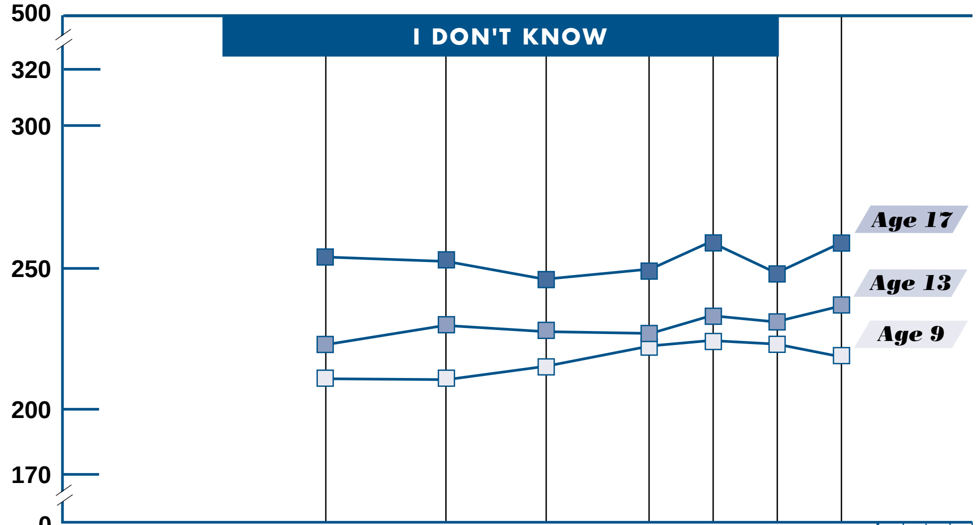
	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	284(0.8) 33(0.6)	275(1.6) 29(0.9)	277(2.0) 28(1.1)	276(1.4) 26(1.1)	280(2.4) 21(0.9)	279(1.7) 22(0.8)	282(2.5) 21(1.1)				+
Age 13	245(1.1) 33(0.6)	243(1.3) 26(1.1)	245(1.4) 31(1.3)	247(1.3) 27(0.8)	246(1.4) 23(0.9)	247(1.2) 23(0.9)	248(1.7) 23(1.0)				
Age 9	223(1.4) 27(0.5)	218(3.3) 15(1.1)	220(1.5) 16(0.7)	226(1.7) 16(0.7)	222(1.9) 14(0.7)	225(1.4) 14(0.6)	222(2.3) 13(0.6)				



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	265(1.3) 15(0.9)	259(2.4) 13(0.7)	258(3.1) 8(0.4)	261(2.8) 8(0.6)	262(3.8) 8(0.6)	256(4.2) 7(0.5)	259(4.0) 6(0.7)				
Age 13	224(1.3) 13(0.7)	225(1.9) 10(0.6)	229(2.7) 8(1.1)	233(2.1) 8(0.5)	234(2.9) 6(0.5)	234(2.5) 6(0.4)	230(3.1) 6(0.4)			+	
Age 9	199(2.2) 9(0.4)	198(6.0) 7(0.9)	204(2.9) 4(0.4)	210(2.7) 5(0.4)	217(2.6) 4(0.3)	211(3.4) 4(0.4)	210(2.9) 4(0.5)	+		+	

Figure 1.8 (continued)

Trends in Average Science Scale Scores by Parents' Highest Level of Education, 1977 to 1996



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	253(3.2) 4(0.4)	252(3.9) 5(0.8)	245(5.5) 3(0.3)	248(5.5) 3(0.4)	258(7.4) 3(0.3)	247(6.7) 3(0.3)	258(8.1) 2(0.2)				
Age 13	222(1.8) 13(1.1)	229(2.8) 11(1.2)	227(2.7) 8(0.4)	224(2.1) 8(0.5)	232(2.0) 8(0.4)	230(2.5) 8(0.5)	236(2.3) 10(0.6)	+		+	
Age 9	211(1.4) 34(0.7)	211(2.8) 29(1.8)	215(1.5) 35(1.0)	222(1.2) 32(0.8)	224(1.4) 33(0.8)	223(1.9) 30(0.8)	219(1.3) 33(0.9)	+		+	

Below each average scale score, the corresponding percentage of students is presented.
Standard errors of the estimated scale scores and percentages appear in parentheses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1977.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Science Scale Scores by Type of School from 1977 to 1996

In recent years, there has been considerable interest in comparing the performance of students attending public and nonpublic schools. The public versus private school debate was fueled about 15 years ago by a major report which concluded that students in private schools had higher achievement than public school students.[24] Sampling procedures used for the NAEP long-term trend assessments make it possible to report on the performance of 9-, 13-, and 17-year-old students attending public and nonpublic schools.[25] (Results by type of school are not available for extrapolated data.) Previous NAEP assessments have found that nonpublic school students had higher average science scores than their public school peers.[26]

Inferences about the relative effectiveness of public and nonpublic schools should not be solely based on NAEP results, however. Average performance differences between the two types of schools may be related to socioeconomic and sociological factors such as per-pupil expenditures, academic curricula, course-taking patterns, disciplinary climate, and the level of parental aspirations and involvement in students' education.[27] Some research has suggested that differences between the academic performance of students attending public and nonpublic schools are minimal when certain factors are controlled such as parental attitudes, student body stability, level of course work, and general school climate.[28]

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[24] Coleman, J. S., Hoffer, T., & Kilgore, S. (1982). *High school achievement: Public, Catholic, and private schools compared.* Basic Books.

[25] Nonpublic schools include Catholic and other private schools.

[26] Campbell, J. R., Reese, C. M., O'Sullivan, C., & Dossey, J. A. (1996). *NAEP 1994 trends in academic progress.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

[27] Alexander, K. L., & Pallas, A. M. (1983). Private schools and public policy: New evidence on cognitive achievement in public and private schools. *Sociology of Education, 56,* 170-182.

Berliner, D., & Biddle, B. (1996). In defense of schools. *Vocational Education Journal, 71*(3), 36-38.

[28] Mullis, I. V. S., Jenkins, F., & Johnson, E. G. (1994). *Effective schools in mathematics: Perspectives from the NAEP 1992 assessment.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

Figure 1.9 contains trend data on the percentages of students attending public and nonpublic schools and their corresponding science scores. The percentages of students attending public and nonpublic schools showed no specific trend over the assessment years. Among 9- and 13-year-olds in 1996, the average science scores of nonpublic school students were higher than those of their public school peers. In contrast, the apparent difference observed between public and nonpublic students at age 17 was not significant.

Public School Students. For 17-year-old students in public schools, a decline in average scores was observed between 1977 and 1982. Gains have been made since that time, however, and the overall pattern was one of improved performance. The average scores of 9- and 13-year-old public school students showed a pattern of general increase between 1977 and 1996. For all three age groups, the average score in 1996 was higher than in 1977.

Nonpublic School Students. Despite some fluctuations, no consistent pattern of change was evident across the assessments in the science performance of 13- and 17-year-olds attending nonpublic schools. The average scores of 13- and 17-year-olds in 1996 were not significantly different from the average scores in the 1977 assessment. Nine-year-olds showed a general trend of increasing scores over the assessment years, but there was no significant difference between average scores in 1977 and 1996.

Figure 1.9

Trends in Average Science Scale Scores by Type of School, 1977 to 1996

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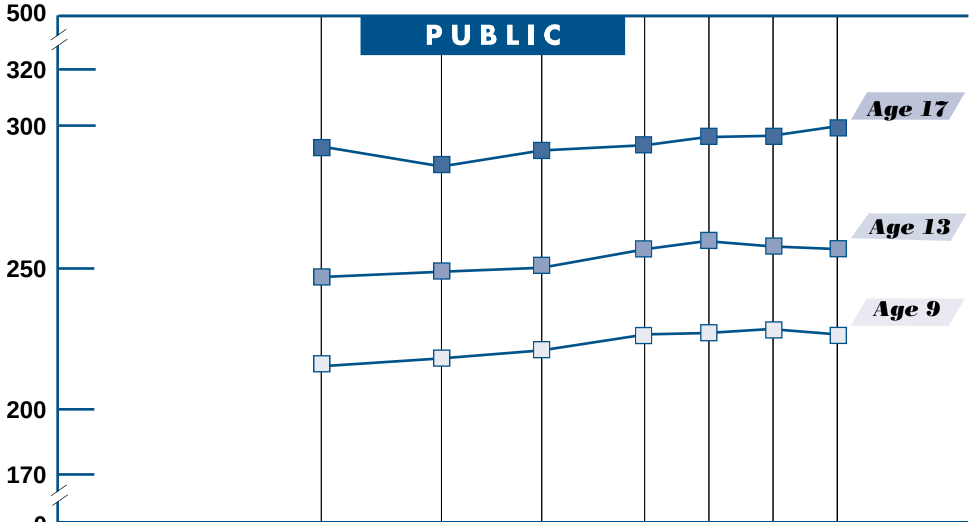
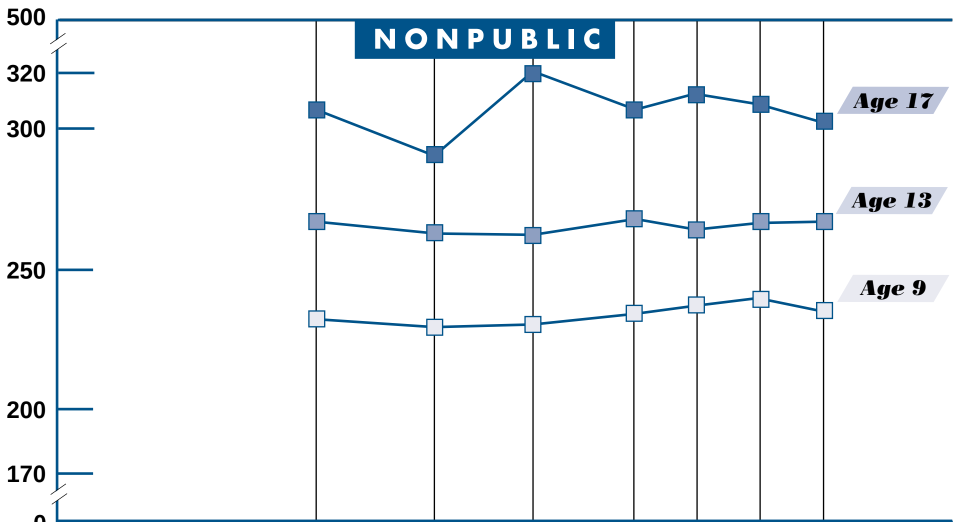


	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	288(1.0) 94(1.8)	282(1.1) 90(2.0)	287(1.6) 96(1.4)	289(1.1) 93(1.8)	292(1.3) 90(2.4)	292(1.5) 88(2.3)	295(1.2) 91(1.7)	+		+	+
Age 13	245(1.2) 90(1.4)	249(1.4) 89(1.7)	251(1.4) 96(1.8)	254(1.1) 90(1.4)	257(1.0) 88(1.9)	255(1.1) 88(1.7)	254(1.1) 89(1.8)	+		+	
Age 9	218(1.4) 89(1.2)	220(2.0) 90(2.3)	223(1.4) 84(2.7)	228(0.9) 89(2.1)	229(1.0) 87(1.6)	230(1.4) 88(1.8)	228(1.3) 87(1.5)	+		+	



	1977	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	308(2.4) 6(1.8)	292(2.9) 10(2.0)	321(10.1) 4(1.4)	308(6.6) 7(1.8)	312(3.7) 9(2.1)	310(4.8) 12(2.3)	304(5.5) 9(1.7)				
Age 13	268(2.1) 10(1.4)	264(3.2) 11(1.7)	263(6.4) 4(1.8)	269(1.8) 10(1.4)	265(2.4) 12(1.9)	268(2.6) 12(1.7)	268(5.0) 11(1.8)				
Age 9	235(2.2) 11(1.2)	232(3.2) 10(2.3)	233(2.9) 16(2.7)	237(2.4) 11(2.1)	240(2.7) 13(1.6)	242(2.8) 12(1.8)	238(4.1) 13(1.5)			+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1977.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Summary

- The science performance of students in all three age groups declined during the first few assessments, but has since improved. For 9- and 13-year-olds, the overall pattern was one of increasing performance, but for 17-year-olds, the overall pattern was one of decreasing performance. For all three groups, average scores in 1996 were not significantly different from those in 1994. Comparing the average scores in 1996 to those in 1969-70, the 1996 average score was higher for 9-year-olds, did not differ significantly for 13-year-olds, and was lower for 17-year-olds.
- The percentages of 9-year-olds at or above Levels 150, 200, 250, and 300 were higher in 1996 than in 1977. Increases also occurred between 1977 and 1996 in the percentages of 13-year-olds reaching Levels 150, 200, and 250, and in the percentages of 17-year-olds reaching Level 300.
- The average science scores of 9- and 13-year-olds in the upper, middle two, and lower quartiles of the performance distribution increased between 1977 and 1996. This pattern was also observed among 17-year-olds in the upper and middle two quartiles, but not among those in the lower quartile.
- Earlier declines and more recent gains characterize the science performance of 9-, 13-, and 17-year-old White students across the assessment years. The overall pattern for 9- and 13-year-olds was one of increased performance. However, the 1996 average scores for 9- and 13-year-olds were not significantly improved over those in 1970, and the 1996 average for 17-year-old students was below that of their counterparts in 1969. In 1996, the average science scores of 9- and 13-year-old Black students were improved over those in 1970. Despite an overall pattern of increased performance for Black 17-year-olds, their average scores in 1969 and 1996 were not significantly different. For 9-, 13-, and 17-year-old Hispanic students, an overall pattern of improved performance was shown. Average scores in 1996 were higher than those in 1977 for 9- and 13-year-olds, but not for 17-year-olds.
- The average science scores of both male and female students at all ages declined during the early assessments, then increased. For male and female students aged 9 and 13, trend analyses revealed an overall pattern of improved performance. Despite the improvements, the 1996 average scores for 9- and 13-year-old males were not significantly higher than those in 1970. For 9-year-old females, the average score was higher in 1996 than in 1970. There was no significant difference between the 1970 and 1996 average scores for age 13 females. For 17-year-old males and females alike, the average score in 1996 was below that in 1969.
- In 1996, White students in all three age groups continued to outperform their Black and Hispanic peers in science. For all three age groups, the overall trend across the assessments was one of narrowing gaps between White and Black students' average scores. For all three age groups, the gap between Black and White students' average science scores was smaller in 1996 than in 1970. For 9- and 17-year-olds, the difference between White and Hispanic students did not change significantly between 1977 and 1996. The magnitude of the gap in 1996 for 13-year-olds was significantly different from that in the first assessment.

- The average score difference between 9-year-old males and females changed little across the assessments. Despite some fluctuation over time among 13-year-olds, the average score difference in 1996 did not differ from that in 1970. The gaps between the average scores of 17-year-old males and females declined over the years and, as a result, the difference in 1996 was smaller than the difference in 1969.
- In the Northeast and Central regions, average scores for 9-year-olds displayed a pattern of early declines followed by gains. In 1996, the average scores for 9- and 13-year-olds in these regions were not significantly different from those in 1970. Among 17-year-olds, the average score in 1996 for students in the Northeast was below that in 1969. Overall patterns of improvement were observed for 9- and 13-year-old students in the Southeast. Average scores for these groups in 1996 were higher than in 1970. For 17-year-olds in the Southeast, declining scores in the 1970s were followed by score increases, however, the average in 1996 did not differ significantly from that in 1970. In the West, the performance of 9- and 13-year-olds tended to improve across the assessment years, although average scores in 1996 did not differ from those in 1970. In 1996, the average score for 17-year-olds in the West was below the average in the first assessment.
- For each age group, increases from 1977 to 1996 were observed in the percentage of students who reported that one or both parents had graduated from college. The percentage of students who reported that their parent(s) had less than a high school education decreased during this time period for all three groups. An increase in average science scores between 1977 and 1996 was observed for 9-year-olds who reported that at least one parent had graduated from college and for 9-year-olds who reported that neither parent had graduated from high school. An overall pattern of improvement was found for 13-year-olds whose parent(s) did not have a high school diploma. For 17-year-olds with at least one parent who graduated from college and for 17-year-olds whose parents' highest level of education was high school graduation, a pattern of early declines in performance was followed by increases. In general, higher science scores were found for students with higher levels of parental education.
- In 1996, the average science scores of 9- and 13-year-old public school students were significantly below those of their nonpublic school peers. No significant difference was observed between public and nonpublic school 17-year-olds. The average scores of 9-, 13- and 17-year-old public school students showed a pattern of general increase, resulting in an average score in 1996 that was higher than that in 1977. Nine-year-old students attending nonpublic schools showed some improvement over the assessments, but did not have a significantly higher average score in 1996 than in 1977. Little change was observed across the assessments for 13- and 17-year-old nonpublic school students; for each group, the average score in 1996 was not significantly different from that in 1977.

Chapter 2

Students' Experiences in Science

Students need many experiences to become scientifically literate individuals who are ready to meet the challenges of the 21st century. Examples of such experiences include taking various types of science courses in school, being exposed to different modes of teaching and learning, and perceiving the role of science in one's life and in world affairs.[29] This chapter looks at the relationship between self-reported student experiences in science class and average science scale scores. Results from the 1996 trend assessment are compared with results from the first assessment in which information on that experience was collected.

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[29] Commission on Precollege Education in Mathematics, Science, and Technology (1983). *Educating Americans for the 21st century: A report to the American people and the National Science Board.* Washington, DC: National Science Board.

The National Science Foundation (1995/1996). *Statewide systemic initiatives in science, mathematics, and engineering.* Arlington, VA.

Project 2061 (1993). *Benchmarks for science literacy.* Washington, DC: American Association for the Advancement of Science.

Clinton, W. J., & Gore, A. (1994). *Science in the national interest.* Executive Office of the President. Washington, DC: Office of Science and Technology Policy.

National Research Council (1995). *National science education standards.* Washington, DC.

Participation in Scientific Experiments and Use of Equipment at Age 9

The central role of investigation in science teaching and learning has received much attention in recent years.[30] Hands-on experiences and the use of common science instruments are necessary parts of scientific investigation. Nine-year-olds were asked whether they had ever worked on or experimented with real-life scientific objects such as living animals and plants. Students were also asked whether they had ever used specific scientific instruments such as a microscope or thermometer. Table 2.1 compares 1977 and 1996 age 9 students' reported participation in five types of science experiments. Data on students' use of specific instruments are presented in Table 2.2. Average science scale scores are also displayed in the tables.

In 1996, 67 percent of 9-year-old students reported that they had experimented with living plants, which was not significantly different from the 70 percent reported in 1977. In 1996, 43 percent of students indicated that they had experience with living animal experiments. This percentage was decreased from 1977 when 55 percent reported experience with this type of experiment. There was no significant difference between 1977 and 1996 in students' reports of having experimented with batteries and bulbs. About 38 percent of

Table 2.1 Participation in Scientific Experiments at Age 9, 1977 and 1996

9-Year-Olds' Reporting on Having Experimented with...	Year	Students Answering "YES": Percent of Students	Students Answering "YES": Average Scale Score	Students Answering "NO": Percent of Students	Students Answering "NO": Average Scale Score
Living plants	1996	67 (1.5)	234 (2.4) *	28 (1.5)	224 (2.6)
	1977	70 (1.4)	221 (2.3)	27 (1.3)	217 (2.8)
Living animals	1996	43 (1.4) *	227 (2.9) *	53 (1.5) *	233 (2.1)
	1977	55 (1.5)	216 (2.8)	42 (1.3)	227 (2.1)
Batteries and bulbs	1996	52 (2.2)	234 (2.9)	41 (2.1)	227 (2.8) *
	1977	51 (1.4)	225 (2.8)	43 (1.4)	217 (2.1)
Shadows	1996	38 (1.7)	233 (2.9) *	54 (1.9)	231 (2.4) *
	1977	42 (1.6)	222 (3.1)	55 (1.7)	220 (1.9)
Dissolving things in water	1996	64 (1.7)	235 (2.6) *	28 (1.4)	225 (2.6) *
	1977	69 (1.4)	223 (2.0)	26 (1.2)	215 (2.6)

Standard errors of the estimated percentages and scale scores appear in parentheses.

Percentages may not total 100 because a small percentage of students responded "not certain" to each item.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1977.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[30] National Research Council (1995). National science education standards. Washington, DC.

Project 2061 (1993). *Benchmarks for science literacy.* Washington, DC: American Association for the Advancement of Science.

9-year-old students in 1996 reported having experience with shadow experiments; this result did not differ significantly from the percentage reported in 1977. Likewise, the percentage of 9-year-olds who had participated in experiments involving dissolving things in water showed no significant change between 1977 and 1996.

In 1996, students who reported having worked with living plants and dissolving things in water had higher average science scores than students without these experiences. No significant score differences were found between 9-year-olds with and without experience experimenting with shadows, living animals, or batteries and bulbs.

Regarding the use of scientific equipment, most 9-year-olds in 1996 reported that they had used a thermometer (91 percent) and a calculator (97 percent), and 73 and 77 percent indicated they had used a directional compass and stopwatch, respectively. All of these percentages were higher than in 1977. There were no significant differences in the percentages of students in 1996 and 1977 who reported using scales and microscopes.

In 1996, 9-year-olds who answered in the affirmative to each question concerning use of scientific instruments had higher average science scores than those who answered in the negative. (A comparison could not be made between students' responses to the question about calculator use due to the insufficient sample size of students responding "No" in 1996.)

Table 2.2

Use of Scientific Equipment at Age 9, 1977 and 1996

THE NATION'S REPORT CARD naep

9-Year-Olds' Reporting on Having Used a...	Year	Students Answering "YES" Percent of Students	Students Answering "YES" Average Scale Score	Students Answering "NO" Percent of Students	Students Answering "NO" Average Scale Score
Scale to weigh things	1996	89 (0.8)	235 (1.8) *	9 (0.6)	217 (4.0) *
	1977	89 (0.8)	220 (2.3)	9 (0.7)	202 (4.5)
Thermometer	1996	91 (0.8) *	234 (1.8) *	7 (0.7) *	208 (5.1)
	1977	84 (1.0)	222 (2.2)	14 (0.9)	199 (2.7)
Microscope	1996	58 (1.9)	238 (2.2) *	36 (1.7) *	224 (1.8) *
	1977	53 (1.4)	222 (2.5)	43 (1.5)	214 (2.1)
Calculator	1996	97 (0.5) *	233 (1.8) *	2 (0.3) *	*** (***)
	1977	87 (1.2)	222 (2.2)	11 (1.0)	195 (3.4)
Compass	1996	73 (1.1) *	235 (1.8) *	23 (1.1) *	225 (2.6) *
	1977	61 (1.3)	222 (2.3)	33 (1.2)	214 (2.7)
Stopwatch	1996	77 (1.1) *	236 (1.9) *	20 (0.9) *	219 (2.9)
	1977	44 (1.3)	223 (2.6)	49 (1.2)	215 (2.5)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1977.

*** Sample size is insufficient to permit a reliable estimate.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Science Course Taking at Ages 9, 13, and 17

Since 1986, NAEP has gathered information about the percentages of students studying certain science subjects. Nine-year-olds were asked how frequently they have science class in school. Results for the nation are shown in Table 2.3. In 1996, the majority of students reported having science class "Every day" (30 percent) or "Several times a week" (31 percent). About one-fourth of 9-year-olds responded "About once a week" (18 percent) or "Less than once a week" (6 percent). About 15 percent responded that they "Hardly ever or never" had science class in school. No difference was observed between the percentages in 1986 and those in 1996. In 1996, 9-year-olds who reported "Hardly ever or never" having science class had lower average science scores than their peers who reported having class about once a week or more frequently.

Table 2.3 Frequency of Science Classes at Age 9 for the Nation, 1986 and 1996

THE NATION'S REPORT CARD naep

9-Year-Olds' Reports of Frequency of Science Class...	Year	Percent of Students	Average Scale Score
Hardly ever or never	1996	15 (0.9)	216 (1.6)
	1986	17 (1.3)	211 (2.5)
Less than once a week	1996	6 (0.4)	223 (4.7)
	1986	6 (0.5)	219 (3.4)
About once a week	1996	18 (0.8)	225 (2.1)
	1986	19 (1.1)	222 (2.1)
Several times a week	1996	31 (1.3)	237 (1.7)
	1986	31 (1.5)	232 (1.7)
Every day	1996	30 (1.6)	234 (2.0)
	1986	28 (2.0)	227 (2.1)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1986.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Thirteen-year-old students in 1996 were asked what they were mainly studying in their current science class. Results for the nation are shown in Table 2.4. Of the 97 percent who were studying science, about equal percentages reported studying life science (21 percent), physical science (22 percent), and earth science (19 percent). In 1996, 28 percent reported studying a mixture of these three (general science), which was an increase over the percentage reported in 1986. The only significant change between 1986 and 1996 in average science scores was an increase among students primarily studying life science. In 1996, 13-year-olds who reported that the content of their science class was mainly life, physical, earth, or general science had higher average science scores than their peers who reported "Other" as the content or who reported that they were not taking a science class.

Table 2.4

Content of Science Classes at Age 13 for the Nation , 1986 and 1996

THE NATION'S REPORT CARD naep

13-Year-Olds' Reports on the Content of Their Science Class...	Year	Percent of Students	Average Scale Score
Not taking science	1996	3 (0.8)	237 (4.9)
	1986	8 (1.8)	242 (4.5)
Life science	1996	21 (1.2)	253 (1.8) *
	1986	19 (2.4)	243 (2.3)
Physical science	1996	22 (1.9)	260 (1.8)
	1986	22 (2.9)	260 (2.8)
Earth science	1996	19 (1.8)	266 (2.1)
	1986	24 (3.5)	259 (2.3)
General science	1996	28 (1.7) *	259 (1.5)
	1986	20 (2.0)	255 (1.8)
Other	1996	7 (0.6)	242 (3.0)
	1986	6 (1.7)	245 (6.2)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1986.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Many school curricula follow the sequence of biology, chemistry, and physics. Therefore, most students have studied biology by the time they are 17 years old. Age 17 students were asked whether they were taking or had taken a course in general science, biology, chemistry, and physics. Tables 2.5 and 2.6 present the percentages of 17-year-old students taking these courses, and their average science scores. Results are given for the nation and by gender in Table 2.5, and for racial/ethnic groups in Table 2.6.

In 1996, nearly all 17-year-olds (94 percent) reported that they had taken or were currently taking biology, and 85 percent reported taking general science. Fifty-six percent reported taking chemistry, while relatively few students (14 percent) reported taking physics. For biology and chemistry, the national percentages were higher in 1996 than in 1986. For general science and physics, the 1986 and 1996 percentages were not significantly different. A direct comparison of average science scores in 1996 and 1986 showed that the average score in 1996 was higher than the previous decade for students who had taken general science and biology. Among 17-year-olds who had taken chemistry or physics, the 1996 average score was not significantly improved over the average in 1986.

Gender. Reflecting results for the nation, the percentages of male and female students taking biology and chemistry increased from 1986 to 1996. At the same time, the percentage of females taking physics increased, while no significant differences were observed for males or females in the percentages taking general science. In 1996, a higher percentage of 17-year-old females than males reported taking biology and chemistry, however, the percentage of males taking physics was higher than the percentage of females.

Comparisons of average scores in 1996 to those in 1986 showed improvement among females taking general science, biology, and physics. In contrast, no significant change was observed between 1986 and 1996 in the performance of males taking general science, biology, chemistry, or physics. Comparisons of average science scores between age 17 males and females in 1996 showed a number of significant differences between the two groups. Males taking general science, biology, and chemistry outperformed their female counterparts. No significant difference in performance was found between males and females taking physics, however.

Table 2.5 **Science Course Taking at Age 17, for the Nation and by Gender, 1986 and 1996**

17-Year-Olds' Reports on Taking Science Courses in...	Year	TOTAL Percent of Students	TOTAL Average Scale Score	MALE Percent of Students	MALE Average Scale Score	FEMALE Percent of Students	FEMALE Average Scale Score
General science	1996	85 (1.6)	297 (1.2) *	85 (1.6)	301 (1.7)	84 (1.8)	293 (1.3) *
	1986	83 (1.3)	290 (1.3)	84 (1.5)	298 (1.7)	82 (1.6)	283 (1.6)
Biology	1996	94 (0.8) *	300 (1.3) *	92 (1.2) *	305 (1.8)	95 (0.7) *	295 (1.5) *
	1986	88 (1.0)	294 (1.5)	87 (1.1)	301 (1.8)	88 (1.1)	287 (1.7)
Chemistry	1996	56 (1.6) *	315 (1.9)	53 (2.2) *	322 (2.7)	58 (1.7) *	310 (2.1)
	1986	40 (1.6)	312 (2.1)	42 (1.8)	319 (2.7)	39 (2.1)	304 (2.2)
Physics	1996	14 (1.1)	309 (3.0)	16 (1.3)	311 (3.7)	12 (1.0) *	306 (4.0) *
	1986	11 (0.9)	296 (4.7)	14 (1.3)	305 (6.8)	8 (0.7)	282 (3.8)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1986.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Race/Ethnicity. Table 2.6 presents trends in science course taking by race/ethnicity. Nearly all White (95 percent) and Black (94 percent) 17-year-old students in 1996 reported taking biology. The corresponding figure for Hispanic students was 87 percent. The percentage of White students who had taken biology was higher in 1996 than in 1986. Among all three racial/ethnic groups, the percentage of students taking chemistry increased considerably from 1986 to 1996, while no significant percentage changes were observed for any racial/ ethnic group in physics.

For White 17-year-olds, average science scores among students taking general science and biology increased between 1986 and 1996. The performance of Black students taking physics also improved during this time period, but no significant differences were observed among Hispanic students taking any science subject. (It should be noted that the sample size of Hispanic students taking physics was insufficient to reliably estimate scale scores.)

In 1996, a higher percentage of White students than Black students reported taking general science. A greater percentage of Black students than White students, however, reported taking physics. About 58 percent of White 17-year-olds reported taking chemistry, which was higher than the 46 percent of Hispanic students. In 1996, White students had higher average science scores than their Black and Hispanic peers at each level of science course work. In interpreting these findings, it should be considered that science courses covering the same topic may vary in content and instructional approach from school to school and from state to state.

Table 2.6

Science Course Taking at Age 17, by Race/Ethnicity, 1986 and 1996

THE NATION'S REPORT CARD naep

17-Year-Olds' Reports on Taking Science Courses in...	Year	WHITE Percent of Students	WHITE Average Scale Score	BLACK Percent of Students	BLACK Average Scale Score	HISPANIC Percent of Students	HISPANIC Average Scale Score
General science	1996	86 (2.0)	306 (1.4) *	78 (1.9)	264 (2.5)	84 (2.8)	274 (2.9)
	1986	84 (1.6)	297 (1.5)	83 (2.6)	257 (2.8)	82 (3.5)	264 (4.5)
Biology	1996	95 (0.8) *	309 (1.3) *	94 (1.6)	266 (2.3)	87 (3.8)	276 (2.6)
	1986	89 (1.1)	301 (1.8)	84 (2.7)	260 (3.1)	84 (3.4)	265 (3.7)
Chemistry	1996	58 (1.9) *	323 (1.9)	49 (3.0) *	284 (3.8)	46 (3.6) *	293 (3.8)
	1986	43 (1.8)	317 (2.2)	29 (2.6)	275 (6.4)	24 (2.2)	281 (8.7)
Physics	1996	12 (1.3)	323 (4.4)	19 (1.6)	270 (4.3) *	16 (2.7)	*** (***)
	1986	10 (0.8)	316 (4.4)	18 (3.5)	239 (5.4)	13 (2.8)	*** (***)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1986.

*** Sample size is insufficient to permit a reliable estimate.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Attitudes About the Value of Science at Ages 13 and 17

Students aged 13 and 17 were asked whether they agreed or disagreed with three statements about the value of science (Table 2.7). To determine whether attitudes have changed over time, the percentages of students in 1996 who agreed with these statements about the value of science were compared to the corresponding percentages in 1977. In general, relatively few changes in attitude were observed across the years. The only significant change was an increase in the percentage of 17-year-olds who agreed that science should be required in school. Among 17-year-olds, higher scores were observed in 1996 than in 1977 among those who agreed with each statement about the value of science.

Table 2.7 Attitudes About the Value of Science at Ages 13 and 17, 1977 and 1996

THE NATION'S REPORT CARD naep

			STRONGLY AGREE OR AGREE		UNDECIDED, DISAGREE, OR STRONGLY DISAGREE	
	Age	Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
Much of what you learn in science classes is useful in everyday life.	13	1996	56 (1.2)	256 (2.1)	44 (1.2)	255 (1.4)
		1977	58 (1.4)	249 (2.3)	43 (1.4)	256 (2.1)
	17	1996	55 (1.5)	299 (2.0) *	45 (1.5)	297 (2.5)
		1977	53 (1.2)	290 (2.4)	47 (1.2)	293 (1.8)
Much of what you learn in science classes will be useful in the future.	13	1996	71 (1.5)	257 (1.9)	29 (1.5)	250 (1.7)
		1977	75 (1.2)	251 (2.1)	26 (1.2)	255 (2.8)
	17	1996	68 (1.2)	301 (1.7) *	32 (1.2)	293 (2.9)
		1977	65 (1.3)	292 (2.0)	35 (1.3)	290 (2.0)
Science should be required in school.	13	1996	71 (1.6)	257 (1.9)	29 (1.6)	250 (2.1)
		1977	70 (1.2)	252 (2.1)	30 (1.2)	252 (2.5)
	17	1996	76 (1.1) *	302 (1.7) *	24 (1.1) *	288 (2.5)
		1977	62 (1.1)	292 (2.0)	38 (1.1)	291 (2.4)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1977.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Thirteen- and 17-year-old students were also asked to respond to questions about the application of science in helping to remedy real-life problems. Table 2.8 shows the 1977 and 1996 percentages of students responding “Very much” to these questions.

Increases were observed in the percentages of 13-year-olds who agreed “Very much” that science applications could help prevent energy shortages, find cures for diseases, control weather, prevent birth defects, save natural resources, and reduce pollution. A decrease between 1977 and 1996 was observed for the statement about preventing starvation. In fact, the percentage of 13-year-olds in 1996 who felt that science could help prevent world starvation (16 percent) was just half that observed in 1977 (32 percent).

Among 17-year-olds, there were increases in the percentages of students who responded “Very much” to statements about the applications of science in preventing energy shortages, preventing birth defects, saving natural resources, and reducing pollution. A smaller percentage of students in 1996 than in 1977 agreed that science applications could help prevent world starvation and reduce overpopulation. As was observed at age 13, the percentage of 17-year-olds who expressed a belief that science could help prevent starvation dropped by about half (from 51 to 24 percent) between 1977 and 1996.

Table 2.8

Perceived Applications of Science at Ages 13 and 17, 1977 and 1996

How much do you think that the application of science can help...		PERCENTAGE OF STUDENTS RESPONDING "VERY MUCH"	
		AGE 13	AGE 17
Prevent world starvation?	1996	16 (0.9) *	24 (1.1) *
	1977	32 (1.5)	51 (1.2)
Save us from an energy shortage?	1996	67 (1.4) *	74 (1.2) *
	1977	54 (1.7)	70 (1.0)
Find cures for diseases?	1996	75 (1.2) *	87 (0.9)
	1977	70 (1.5)	85 (0.8)
Control weather?	1996	21 (1.0) *	18 (1.6)
	1977	15 (0.9)	16 (0.8)
Prevent birth defects?	1996	39 (1.4) *	53 (1.3) *
	1977	23 (1.2)	44 (1.2)
Save our natural resources?	1996	59 (1.7) *	59 (1.3) *
	1977	47 (1.1)	48 (1.2)
Reduce air and water pollution?	1996	56 (1.0) *	60 (1.2) *
	1977	44 (1.2)	54 (1.2)
Reduce overpopulation?	1996	13 (1.1)	14 (0.8) *
	1977	11 (0.8)	22 (0.8)

Standard errors of the estimated percentages appear in parentheses.
* Indicates that the percentage in 1996 is significantly different than that in 1977.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Summary

- No significant differences were observed between 1977 and 1996 in the percentage of 9-year-olds who reported having experimented with living plants, batteries and bulbs, shadows, and dissolving things in water. A smaller percentage of students in 1996 than in 1977 reported having experimented with living animals. In 1996, students who had experience working with living plants and dissolving things in water had higher average science scores than students without these experiences.
- A higher percentage of 9-year-old students in 1996 than in 1977 had used scientific equipment. The only exception was use of a microscope and a scale to weigh things, which did not change significantly between 1977 and 1996. For all types of equipment, students who had used each instrument had higher average science scores than students who had not.
- No significant differences between 1986 and 1996 were observed in the percentages of 9-year-olds' reports on frequency of science class. In 1996, the majority of students reported having science class at least several times a week. Only 15 percent of 9-year-olds reported never or hardly ever having science class.
- Among 13-year-olds, an increase between 1986 and 1996 was observed in the percentage of students taking general science. No significant differences were found in the percentages taking life science, physical science, or earth science. Higher average science scores in 1996 than in 1986 were found for 13-year-old students studying life science.
- Between 1986 and 1996, increases were observed in the percentages of 17-year-old students who had taken biology and chemistry. At the same time, no significant differences were found in the percentages taking general science or physics. Between 1986 and 1996, average score increases were found for 17-year-old students who had taken general science and biology, but no significant differences were observed among those taking chemistry or physics.
- In 1996, the percentage of age 17 male and female students taking biology and chemistry had increased since 1986, as had the percentage of females taking physics. No significant percentage increases were observed in general science course taking for either group. In 1996, a higher percentage of female than male students reported taking biology and chemistry. The percentage of male students taking physics was higher than for females.
- Between 1986 and 1996, average score increases were observed for female students taking general science, biology, and physics. No significant increases in performance were found for male students.
- Among White 17-year-olds, a greater percentage reported taking biology in 1996 than in 1986. The percentage of Black and Hispanic students taking biology did not change significantly during this time period. For all three racial groups, a higher percentage of students in 1996 than in 1986 reported taking chemistry. No significant changes were observed for physics, however. For White students, average science scores among students taking biology and general science increased between 1986 and 1996. The performance of

Black students taking physics also rose over this time period. No significant score improvements at any level of course work were observed for Hispanic students. White students had higher average science scores than their Black and Hispanic peers at each level of course work.

- No significant differences between 1977 and 1996 were observed in 13-year-olds' attitudes about the value of science. The percentage of 17-year-olds who agreed that science should be required in school increased between 1977 and 1996. For this same age group, the average science score increased for those who agreed that science classes are useful in everyday life, that science will be useful in the future, and that science should be required in school.

- The percentages of 13- and 17-year-olds who believed that science can help solve societal problems were generally higher in 1996 than in 1977, although there were some exceptions. Most notably, 13- and 17-year-olds in 1996 were less likely than those in the earlier assessment to believe that science can help prevent starvation, and 17-year-old students were less likely to believe that science can reduce overpopulation. No significant differences between 1977 and 1996 were observed in the percentage of 13-year-olds who believed that science can help reduce overpopulation, or in the percentages of 17-year-olds who agreed that science applications can help find cures for diseases and control weather.

Part II Mathematics

Introduction

In 1989, the National Council of Teachers of Mathematics (NCTM) established a set of standards for school mathematics.[1] The introduction of the NCTM standards has been a landmark in educational improvement, and since then, much attention has been given to the discipline and its role in the school curriculum. This attention has resulted in the reworking of school curricula and teaching programs, increased focus on faculty development in mathematics, and advances in assessing student progress in the subject.[2] As we approach the year 2000, eyes are beginning to focus on what effects, if any, these efforts have had on student achievement and improved practices in the classroom.

The 1996 NAEP long-term trend assessment in mathematics is one of many programs that can shed light on these questions. This program, initiated in 1973, provides a baseline look at long-term trends in student mathematics performance, as well as students' experiences related to mathematics learning. The NAEP 1996 long-term trend assessment in mathematics was the eighth of its kind, with previous assessments conducted in the 1972-73, 1977-78, 1982-83, 1985-86, 1989-90, 1991-92, and 1993-94 school years.[3] Each of these mathematics assessments, which will subsequently be referred to by the last half of the school year in which it occurred, involved a nationally representative sample of 9-, 13-, and 17-year-old students. It should be noted that some of the analyses reported in this section, including data on students' experiences in mathematics, do not go back to the first mathematics trend assessment because the data are not available.

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1 National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA.

2 Garet, M. S., & Mills, V. L. (1995). Changes in teaching practices: The effects of the curriculum and evaluation standards. *Mathematics Teacher,* 88, 380-388.

Joyner, J. M. (1995). Implementing the assessment standards for school mathematics: NCTM's assessment standards: A document for all educators. *Teaching Children Mathematics,* 2, 20-22.

Lindquist, M. M. (1993). Tides of change: Teachers at the helm. *Arithmetic Teacher,* 41, 64-68.

3 Campbell, J. R., Reese, C. M., O'Sullivan, C. Y., & Dossey, J. A. (1996). *NAEP 1994 trends in academic progress.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

The NAEP Long-Term Trend Mathematics Assessment

The National Assessment of Educational Progress conducts two different kinds of assessments in mathematics: main NAEP and long-term trend. Unlike the main NAEP mathematics assessments that collect national data for students in grades 4, 8, and 12 and state data for grades 4 and 8,[4] the long-term trend assessments replicate NAEP's initial data-gathering process of sampling students from across the country at ages 9, 13, and 17. Another difference is that the mathematics long-term trend assessments employ a different set of questions, reflecting a more limited view of the curriculum than the questions newly developed for the 1990, 1992, and 1996 main NAEP national- and state-level mathematics assessments.[5] These newly developed assessments focus more heavily on students' performance and associated achievement levels related to the use of manipulatives and performance on constructed-response questions. They also contain extended sets of background questions concerning the context of students' mathematics learning experience both in and out of school. Because the content of the main NAEP mathematics series differs from that of the long-term trend assessment, and because the populations differ due to the age-versus-grade sampling methods, the results of the two assessments are not directly comparable.

The present work provides a supporting picture of school achievement in a time of reform and change. While the main assessments associated with the national- and state-level NAEP work provide a glimpse of change and progress by grade levels, the long-term trend studies provide a picture of how 9-, 13-, and 17-year-old students are performing on a set of questions developed to measure long-held objectives for school mathematics. These mathematics objectives were set in the late 1960s. Today, they represent a somewhat constrained view of mathematics. As a result, the assessment is more heavily weighted toward students' knowledge of basic facts and the ability to carry out numerical algorithms using paper and pencil, exhibit knowledge of basic measurement formulas as they are applied in geometric settings, and complete questions reflecting the direct application of mathematics to daily-living skills (such as those related to time and money). During this time of change and reform in the mathematics curriculum,[6] when classrooms may be placing more emphasis on processes such as problem solving and communication mathematics, the NAEP long-term trend assessment's results provide an index of whether students are losing ground with respect to long-held goals. The long-term trend for the three age groups indicates that, although curriculum goals have been altered to focus more heavily on problem solving, conceptual development, reasoning, and communication skills, there has been no downward movement in student performance on questions designed to measure more traditional procedural aspects of the mathematics curriculum.

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4 Reese, C. M., Miller, K. E., Mazzeo, J., & Dossey, J. A. (1997). *NAEP 1996 mathematics report card for the nation and the states.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office

5 National Assessment of Educational Progress (1988). *Mathematics objectives: 1990 assessment.* Princeton, NJ.
National Assessment Governing Board (1995). *Mathematics framework for the 1996 national assessment of educational progress.* Washington, DC.

6 National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA.

The computational focus of the long-term trend assessment also provides an anchor for how well our students are measuring up to traditional procedural skills as the calculator plays an increasingly greater role in the mathematics curriculum from kindergarten through the undergraduate level. Calculators are allowed for a few questions on the long-term trend assessment, but most questions are multiple-choice and are completed without the use of a calculator.

Analysis Procedures

The results from the eight NAEP long-term trend assessments in mathematics provide a wide range of information about how students' performance has changed during the 23-year period from 1973 to 1996. Estimates of average student performance in the mathematics trend assessments were calculated using analysis techniques based on item response theory (IRT). The NAEP mathematics scale, which ranges from 0 to 500, provides a common metric for comparing average performance across trend assessments, age groups, and demographic subpopulations. NAEP has also developed descriptions for student performance at five levels on the scale:

Level 150 – Simple Arithmetic Facts;

Level 200 – Beginning Skills and Understandings;

Level 250 – Basic Operations and Beginning Problem Solving;

Level 300 – Moderately Complex Procedures and Reasoning; and

Level 350 – Multistep Problem Solving and Algebra.

NAEP reports the performance of groups and subgroups of students, not individuals. The measures of achievement included in this report are the average performance of groups of students on the NAEP mathematics scale. Because the average scale scores and the percentages are based on samples of students and are subject to sampling and measurement error, standard errors are included with the results presented here.

The 1996 assessment was statistically compared to two previous assessments: the prior assessment in 1994, and the first assessment which provided sufficient data on the variables being tested (i.e., the base year). The purpose of year-to-year statistical tests was to determine whether the results in the 1996 assessment were different from the results of the previous assessment or whether any changes had taken place since the base year assessment. Tests of other year-to-year comparisons can be found in previous reports of NAEP long-term trend assessments.

In addition to comparisons between individual assessment years, a second test of significance was conducted to detect statistically significant linear and quadratic trends across assessments. (See the Procedural Appendix for a discussion of the procedure.) This type of analysis makes it possible to discuss statistically significant patterns that may be missed by year-to-year comparisons. For example, from assessment to assessment, students' average scale scores may consistently increase (or decrease) by a small amount. Although these small increases (or decreases) between years may not be statistically significant under pairwise multiple comparisons, the overall increasing (or decreasing) trend in average scores may be statistically significant and noteworthy. The purpose of trend tests was to determine whether the results of the series of assessments could be generally characterized by a line or a simple curve. A linear trend tests for cumulative change over the entire assessment period, such as an increase or decrease at a relatively constant rate. Simple curvilinear (i.e., quadratic) relationships represent more complex patterns. Two examples of such patterns include initial score declines over part of the time period followed by subsequent increases in more recent assessments, or a pattern of initial score increases over a time period followed by a period of relatively stable performance.

This Section

The two chapters in Part II concentrate on different aspects of student performance. Trends in average mathematics scale scores for the nation and demographic subpopulations are reported in Chapter 3. Also included are definitions of levels of mathematics performance and information on the percentages of students attaining successive levels in each assessment. Chapter 4 summarizes trends in students' responses to questions relating to school and home contexts for learning mathematics such as classroom activities, course taking, amount of time spent doing homework, and attitudes about mathematics. Results contained in Chapter 4 were based on the 1996 and base year assessments.

In Chapter 3, the results of statistical tests conducted to determine significant differences between 1996 and the first assessment year, and between 1996 and 1994, are indicated in grids that appear next to or below the figures and tables. The results from tests comparing the base year and 1996 assessments are summarized in the column labeled with the asterisk symbol "*." Significant differences are denoted with a "+" or "-" sign indicating that the 1996 average score was either greater than or less than the base year score, respectively. Similarly, significant differences between the 1994 and 1996 assessment results are denoted with a "+" or "–" sign under the column labeled with the dagger symbol "‡" indicating that the 1996 average score was either greater or smaller than the 1994 average, respectively. The results from the linear and quadratic trend tests are summarized in the columns labeled "L" and "Q," respectively. Within each column, significant positive trends are denoted by a "+" sign and significant negative trends are denoted with a "-" sign. In Chapter 4, where only the first and most recent assessment results are presented, significant differences between the base year and 1996 are indicated within the tables. All of the differences and trend patterns discussed in this report are statistically significant at the .05 level.

Chapter 3

Mathematics Scores for the Nation and Selected Subpopulations

Results for the Nation from 1973 to 1996

Figure 3.1 displays trends in average mathematics scores from 1973 to 1996 for 9-, 13-, and 17-year-old students in the United States. The patterns of change, except for the dotted lines between 1973 and 1978, are based on recent scaling analyses developed to provide valid pictures of trends in the data. The dotted lines represent results for the 1973 assessment that were extrapolated from previous NAEP analyses. (The Procedural Appendix provides details about the scaling methodology and information about drawing inferences from the trend analyses.) This figure provides the overall trend in students' knowledge of mathematics over the past 23 years for specific age groups.

Figure 3.1 **Trends in Average Mathematics Scale Scores for the Nation, 1973 to 1996**

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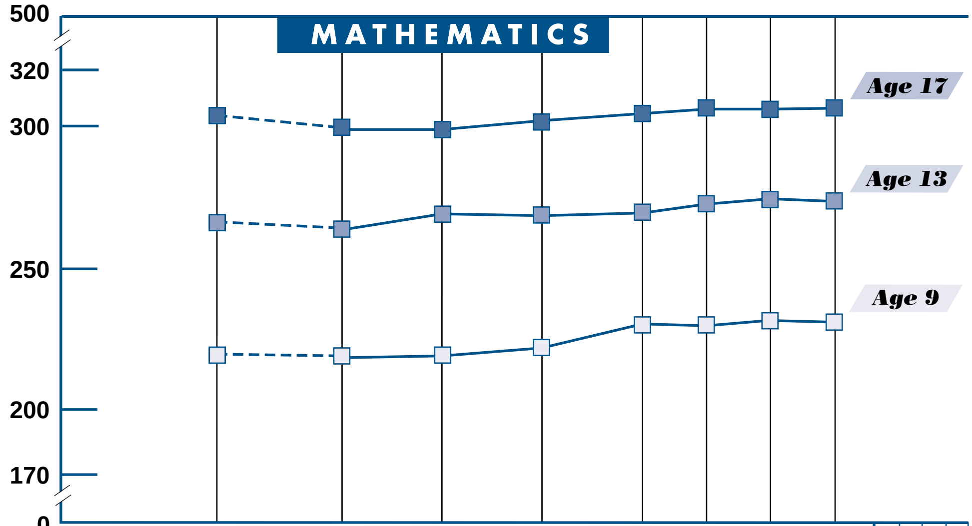

	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	304(1.1)	300(1.0)	299(0.9)	302(0.9)	305(0.9)	307(0.9)	306(1.0)	307(1.2)			+	+
Age 13	266(1.1)	264(1.1)	269(1.1)	269(1.2)	270(0.9)	273(0.9)	274(1.0)	274(0.8)	+		+	
Age 9	219(0.8)	219(0.8)	219(1.1)	222(1.0)	230(0.8)	230(0.8)	231(0.8)	231(0.8)	+		+	+

Standard errors of the estimated scale scores appear in parentheses.
[– – –] Extrapolated from previous NAEP analyses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1973.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Seventeen-year-olds. Among 17-year-olds, a decline in the average mathematics score was observed between 1973 and 1982. Gains have been made since that time however, and the overall pattern was one of increased performance. Despite these gains, the average score in 1996 was not significantly different from the average scores in 1973 or 1994.

Thirteen-year-olds. Thirteen-year-olds displayed an overall pattern of improved performance from 1973 to 1996 that resulted in a 1996 average score that was higher than the 1973 average score. There has been no significant change since 1994.

Nine-year-olds. The average mathematics scores for 9-year-old students were somewhat stable from 1973 to 1982, but increased after that time. The overall trend was one of improved performance, and the average score in 1996 was higher than the average score in 1973, but not significantly different from the 1994 average.

National Trends in Levels of Mathematics Performance from 1978 to 1996

To better understand trends in students' knowledge and skills in mathematics, levels of mathematics performance were created to illuminate the nature of any changes. Five levels were established by "anchoring" five points on the NAEP mathematics scale: 150, 200, 250, 300, and 350.[7] The anchoring was accomplished by determining which questions students performing at one point on the scale were more likely to answer correctly than students performing at the next lower level. Mathematics educators from schools and universities then carefully studied the sets of questions that make up the assessments to develop descriptions for the five levels. These descriptions outline the concepts, procedures, and processes associated with correct responses to the questions at each level. Figure 3.2 provides these descriptions for the five anchor levels.

7 In theory, performance levels above 350 and below 150 could have been defined; however, so few students in the assessment performed at the extreme ends of the mathematics scale that it was not practical to do so.

Figure 3.2 Levels of Mathematics Performance

Level 350:

Multistep Problem Solving and Algebra

Students at this level can apply a range of reasoning skills to solve multistep problems. They can solve routine problems involving fractions and percents, recognize properties of basic geometric figures, and work with exponents and square roots. They can solve a variety of two-step problems using variables, identify equivalent algebraic expressions, and solve linear equations and inequalities. They are developing an understanding of functions and coordinate systems.

Level 300:

Moderately Complex Procedures and Reasoning

Students at this level are developing an understanding of number systems. They can compute with decimals, simple fractions, and commonly encountered percents. They can identify geometric figures, measure lengths and angles, and calculate areas of rectangles. These students are also able to interpret simple inequalities, evaluate formulas, and solve simple linear equations. They can find averages, make decisions based on information drawn from graphs, and use logical reasoning to solve problems. They are developing the skills to operate with signed numbers, exponents, and square roots.

Level 250:

Numerical Operations and Beginning Problem Solving

Students at this level have an initial understanding of the four basic operations. They are able to apply whole number addition and subtraction skills to one-step word problems and money situations. In multiplication, they can find the product of a two-digit and a one-digit number. They can also compare information from graphs and charts, and are developing an ability to analyze simple logical relations.

Level 200:

Beginning Skills and Understandings

Students at this level have considerable understanding of two-digit numbers. They can add two-digit numbers but are still developing an ability to regroup in subtraction. They know some basic multiplication and division facts, recognize relations among coins, can read information from charts and graphs, and use simple measurement instruments. They are developing some reasoning skills.

Level 150:

Simple Arithmetic Facts

Students at this level know some basic addition and subtraction facts, and most can add two-digit numbers without regrouping. They recognize simple situations in which addition and subtraction apply. They also are developing rudimentary classification skills.

The percentages of students at ages 9, 13, and 17 reaching the various performance levels in each of the NAEP long-term trend assessments are shown in Table 3.1.[8] Because these analyses were not possible for data collected for the 1973 mathematics assessment, the results are presented for the 1978 through the 1996 assessments only. (Performance level data are not available for assessment years with extrapolated data.) Data on performance levels by gender, race/ethnicity, modal grade, region, parents' education level, type of school, and quartiles can be found in the Data Appendix.

Table 3.1 — **Trends in Percentage of Students At or Above Five Mathematics Performance Levels, 1978 to 1996**

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Performance Levels	Age	Assessment Years										
		1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Level 350 Multistep Problem Solving and Algebra	9	0 (***)	0 (***)	0 (***)	0 (***)	0 (***)	0 (***)	0 (***)				
	13	1 (0.2)	1 (0.1)	0 (0.1)	0 (0.1)	0 (0.2)	1 (0.2)	1 (0.1)				+
	17	7 (0.4)	6 (0.4)	7 (0.5)	7 (0.6)	7 (0.6)	7 (0.8)	7 (0.8)				
Level 300 Moderately Complex Procedures and Reasoning	9	1 (0.1)	1 (0.1)	1 (0.2)	1 (0.3)	1 (0.3)	1 (0.4)	2 (0.3)	+		+	
	13	18 (0.7)	17 (0.9)	16 (1.0)	17 (1.0)	19 (1.0)	21 (1.4)	21 (1.2)			+	+
	17	52 (1.1)	49 (1.3)	52 (1.4)	56 (1.4)	59 (1.3)	59 (1.4)	60 (1.7)	+		+	
Level 250 Numerical Operations and Beginning Problem Solving	9	20 (0.7)	19 (1.0)	21 (0.9)	28 (0.9)	28 (0.9)	30 (1.1)	30 (1.0)	+		+	
	13	65 (1.2)	71 (1.2)	73 (1.6)	75 (1.0)	78 (1.1)	78 (1.1)	79 (0.9)	+		+	
	17	92 (0.5)	93 (0.5)	96 (0.5)	96 (0.5)	97 (0.5)	97 (0.5)	97 (0.4)	+		+	–
Level 200 Beginning Skills and Understandings	9	70 (0.9)	71 (1.2)	74 (1.2)	82 (1.0)	81 (0.8)	82 (0.7)	82 (0.8)	+		+	
	13	95 (0.5)	98 (0.4)	99 (0.2)	99 (0.2)	99 (0.3)	99 (0.3)	99 (0.2)	+		+	–
	17	100 (0.1)	100 (0.0)	100 (***)	100 (***)	100 (***)	100 (***)	100 (***)				
Level 150 Simple Arithmetic Facts	9	97 (0.3)	97 (0.3)	98 (0.3)	99 (0.2)	99 (0.2)	99 (0.2)	99 (0.2)	+		+	
	13	100 (0.1)	100 (***)	100 (***)	100 (***)	100 (***)	100 (***)	100 (***)				
	17	100 (***)	100 (***)	100 (***)	100 (***)	100 (***)	100 (***)	100 (***)				

Standard errors of the estimated percentages appear in parentheses. When no standard error appears (***), standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions. In these cases statistical tests have not been conducted. (See Procedural Appendix.)

* Indicates that the percentage in 1996 is significantly larger (+) or smaller (–) than that in 1978.

‡ Indicates that the percentage in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[8] The performance levels are based upon a vertical scale that assumes knowledge is cumulative. Younger students are not expected to have the same amount of knowledge as older students. Therefore, most 9-year-olds are not expected to reach the upper levels of performance.

Level 350: In 1996, about 1 percent of 13-year-olds and 7 percent of 17-year-olds attained this highest level of performance in 1996, characterized by the ability to apply a range of reasoning skills to multistep problems. Despite the small fluctuations in percentages among 13-year-olds, the 1996 and 1978 percentages did not differ significantly. Similarly, the percentage of 17-year-olds reaching this level in 1996 did not differ from that in 1978.

Level 300: Compared with those in the lower levels, students performing at or above Level 300 demonstrated better numerical operations and logical reasoning and were able to draw from a wider range of mathematical areas, including algebra and geometry. A higher percentage of age 9 students attained this level in 1996 than in 1978. Despite the small changes over time, the overall pattern was one of increasing percentages. At age 13, the percentage of students reaching this level declined from 1978 to 1986 but subsequently increased. Although the overall trend was one of increased percentages, the percentage in 1996 was not significantly different from that in 1978. The overall trend for 17-year-olds was one of increasing percentages. Sixty percent of 17-year-olds performed at or above this level in 1996, which represented an increase over the percentage in 1978.

Level 250: Students performing at or above Level 250 had developed an understanding of the four basic operations and were beginning to acquire more developed reasoning skills. Thirty percent of 9-year-olds, 79 percent of 13-year-olds, and nearly all 17-year-olds (97 percent) attained this level in 1996. For all three age groups, the percentage in 1996 was higher than that in 1978 and the trend showed an overall pattern of increase. Among 17-year-olds, the gains occurred during the 1980s.

Level 200: Students performing at or above Level 200 demonstrated a greater range and depth of basic mathematical skills than did those who reached only Level 150, but were still developing a grasp of multiplication and division and reasoning ability beyond that required by simple numerical computations. In each assessment since 1978, virtually all 17-year-olds have reached this level. For 9- and 13-year-olds, gains were observed in the 1980s followed by a period of relative stability in the 1990s. About 99 percent of 13-year-olds attained this level in 1996, which was an increase over the percentage in 1978. With 82 percent reaching this level in 1996, age 9 students also showed improvement since 1978.

Level 150: In 1996, nearly all students in each of the three age groups understood simple arithmetic facts as described in Level 150. Despite the small changes for 9-year-olds, percentages increased overall, and the 1996 percentage was higher than the 1978 percentage.

Trends in Mathematics Scale Scores by Quartile from 1978 to 1996

Figure 3.3 presents trends in mathematics scale scores for 9-, 13-, and 17-year-old students who were in the upper quartile (upper 25 percent), middle two quartiles (middle 50 percent), and the lower quartile (lower 25 percent) of student performance in each assessment. Note that these trends are not extrapolated back to 1973. As would be expected, standard errors are generally smaller for these more homogeneous groups than for the total group.

Analyses by quartiles provide information on trends in mathematics scores for students at the upper as well as the lower points along the distribution of scores. These analyses demonstrate whether overall gains or losses were evident across the full range of student performance in mathematics or were particular to certain achievement groups. The overall results are promising with respect to one objective of the third goal of The National Education Goals, which states that "the academic performance of elementary and secondary students will increase significantly in every quartile...."[9] The report emphasizes that students of all abilities should be granted access to educational opportunities and should demonstrate gains in educational achievement. That is, for every age group at each of the performance quartiles, the results illustrate a pattern of improved performance. This suggests that improvement on the trend mathematics assessments has not been limited to a particular segment of the performance distribution.

The trend for each quartile group among 17-year-olds was one of overall improvement. For each quartile group, the average score in 1996 was higher than in 1978. Average scores for students in the upper and lower quartiles showed an increasing trend across the assessments. For 17-year-olds in the middle two quartiles, scores decreased in 1982, but then increased until 1992.

The average score of 13-year-olds in the upper quartile changed little from 1978 through the 1980s, but increased in the 1990s. The overall trend was one of improved performance, and the average score in 1996 was higher than the average in 1978. Among 13-year-olds in the middle two quartiles, average scores showed an overall pattern of improvement across the assessment years. The average score in 1996 was higher than in 1978. In the lower quartile of performance among 13-year-olds, average scores rose between 1978 and 1982, and then displayed a trend of small increases across the assessments. In general, the pattern showed overall improvement with higher scores in 1996 than in 1978.

An overall pattern of increased performance was observed for 9-year-olds in each performance range. All average scores for the three quartile groups were higher in 1996 than in 1978.

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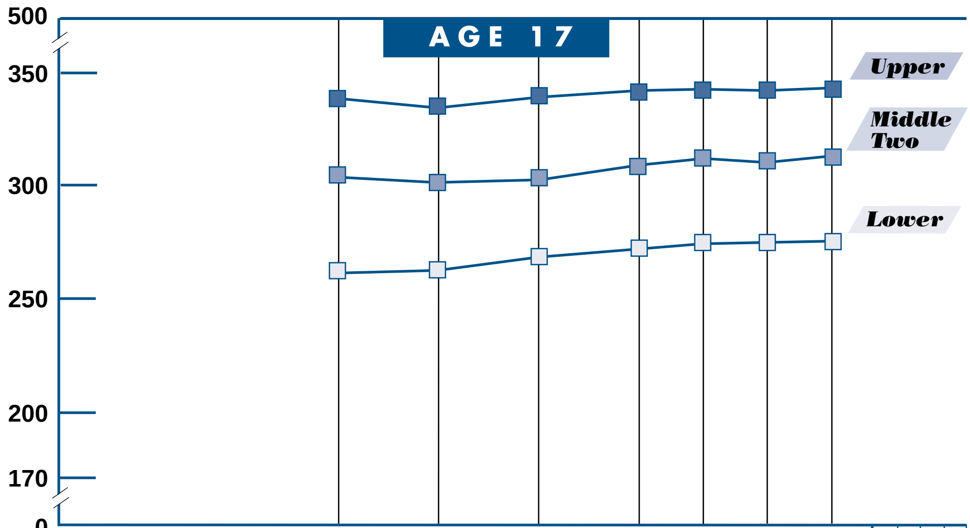
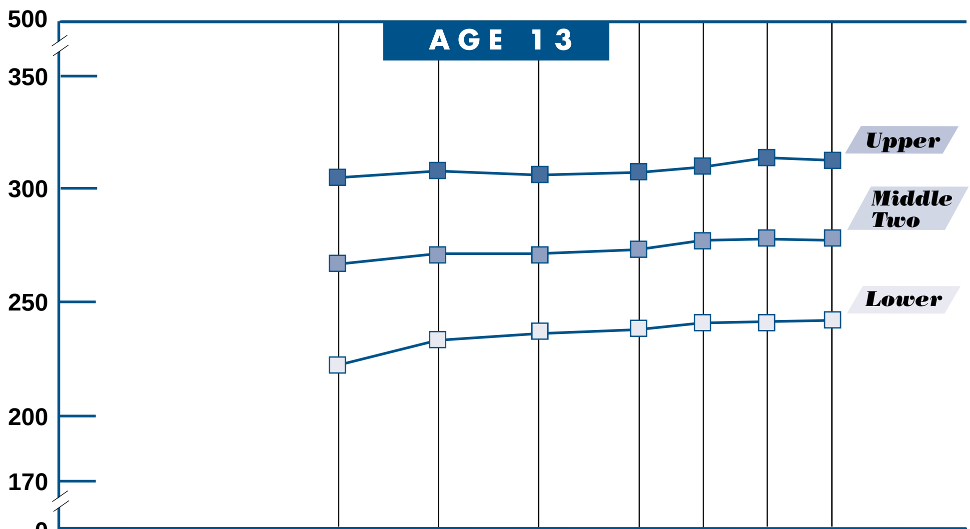
[9] National Education Goals Panel (1996). *The national education goals report: Building a nation of learners.* Washington, DC: U.S. Government Printing Office.

Figure 3.3 Trends in Average Mathematics Scale Scores by Quartile, 1978 to 1996

THE NATION'S REPORT CARD naep



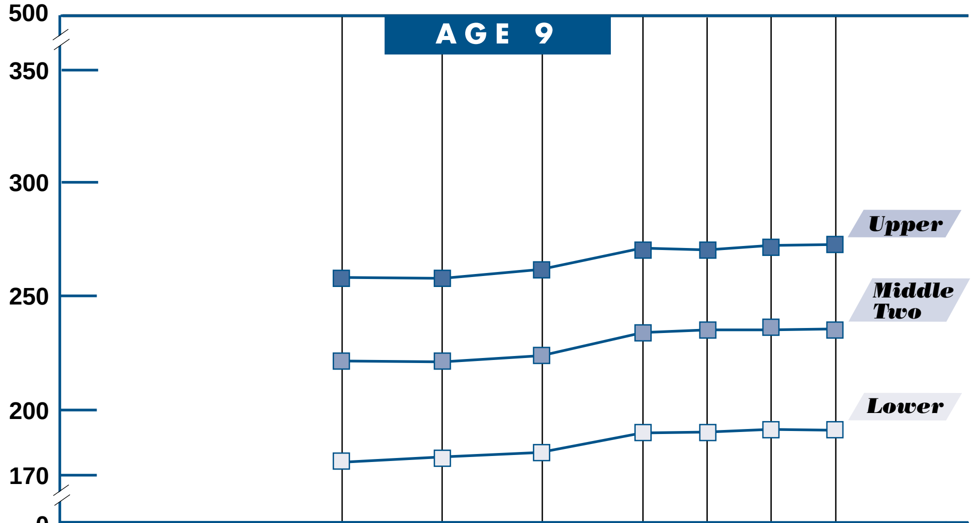
	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	339(0.4)	336(0.6)	340(0.7)	341(0.8)	342(0.7)	342(1.1)	342(0.9)	+		+	
Middle Two	302(0.3)	299(0.3)	301(0.5)	305(0.5)	308(0.4)	307(0.4)	308(0.7)	+		+	+
Lower Quartile	260(0.5)	260(0.7)	265(0.9)	268(0.9)	270(0.9)	270(0.8)	270(0.9)	+		+	



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	305(0.6)	306(0.7)	306(0.7)	307(0.6)	309(0.6)	312(0.9)	311(1.0)	+		+	+
Middle Two	266(0.4)	269(0.3)	269(0.5)	271(0.4)	274(0.4)	275(0.5)	275(0.5)	+		+	
Lower Quartile	221(0.7)	230(0.8)	233(0.7)	234(0.8)	236(1.2)	236(1.0)	237(0.5)	+		+	–

Figure 3.3 (continued)

Trends in Average Mathematics Scale Scores by Quartile, 1978 to 1996



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	256(0.8)	256(0.6)	259(0.7)	266(0.8)	266(0.8)	267(0.8)	268(1.2)	+		+	
Middle Two	221(0.5)	221(0.5)	223(0.5)	231(0.4)	232(0.5)	233(0.6)	232(0.4)	+		+	
Lower Quartile	178(0.6)	179(0.8)	181(0.7)	190(1.0)	190(0.8)	191(0.8)	191(0.9)	+		+	

Standard errors of the estimated scale scores appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1978.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Mathematics Scale Scores by Race/Ethnicity from 1973 to 1996

Displayed in Figure 3.4 are the trends in average mathematics scores for White, Black, and Hispanic students from 1973 to 1996.[10]

White Students. The average score for White 17-year-olds declined between 1973 and 1982, but has increased since that time. Despite an overall positive trend, the average score in 1996 was not significantly higher than it was 23 years earlier. Thirteen-year-old White students displayed a general pattern of increased performance across the assessment years, with the exception of a small decrease in 1978. The average score for White 9-year-old students remained relatively stable from 1973 to 1982, increased until 1990, but has changed little since that time. However, the overall trend was one of increased performance. The 1996 average scores for both 9- and 13-year-old White students were higher than in 1973.

Black Students. For Black students at all three age groups, trend analyses revealed a pattern of overall gains in mathematics across the assessment years. For 13-year-olds, average scores have changed little since 1986. However, the average scores for each age group in 1996 were higher than those in 1973.

Hispanic Students. For 17-year-old Hispanic students, scores were relatively stable in the 1970s, rose between 1982 and 1992, then stabilized. The overall trend was positive, and the average score in 1996 was greater than that in 1973. Following a period of stability in the 1970s, mathematics scores rose dramatically in 1982 for 13-year-old Hispanic students, and then remained relatively stable. The overall pattern was one of increased performance across the assessment years, and the 1996 average was greater than the 1973 average. The average scores of 9-year-old Hispanic students indicate improved performance over the 23-year assessment period. The average score in 1996 was higher than in 1973.

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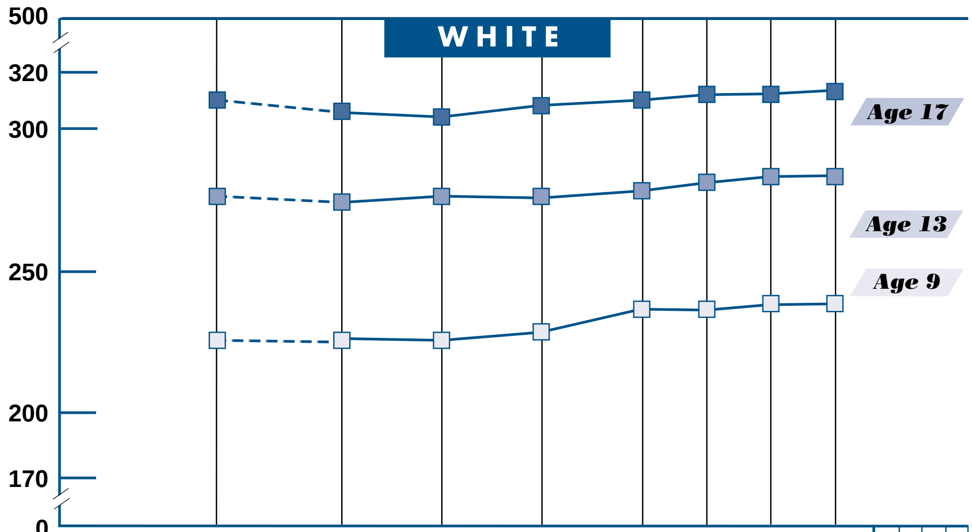
[10] For Asian/Pacific Islander students and American Indian students, the sample sizes were insufficient to permit reliable trend estimates.

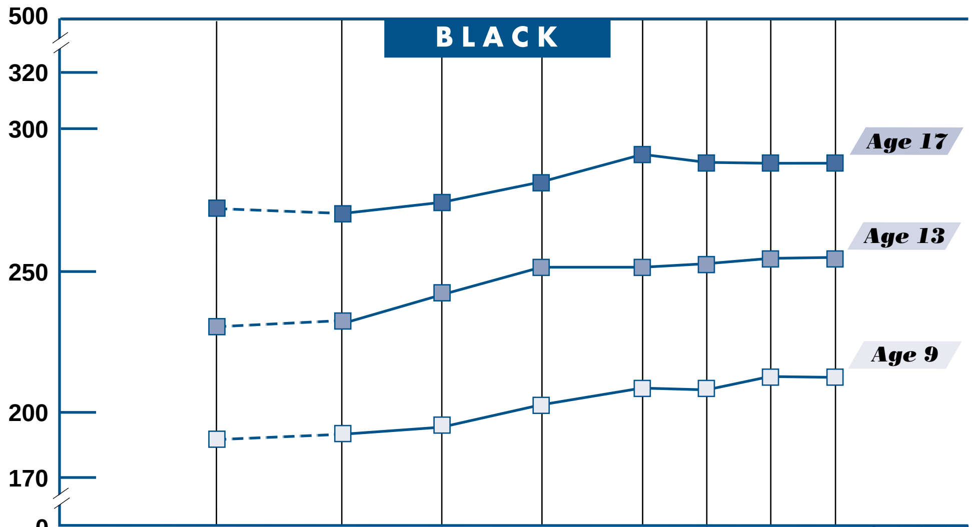
Figure 3.4

Trends in Average Mathematics Scale Scores by Race/Ethnicity, 1973 to 1996

THE NATION'S REPORT CARD naep



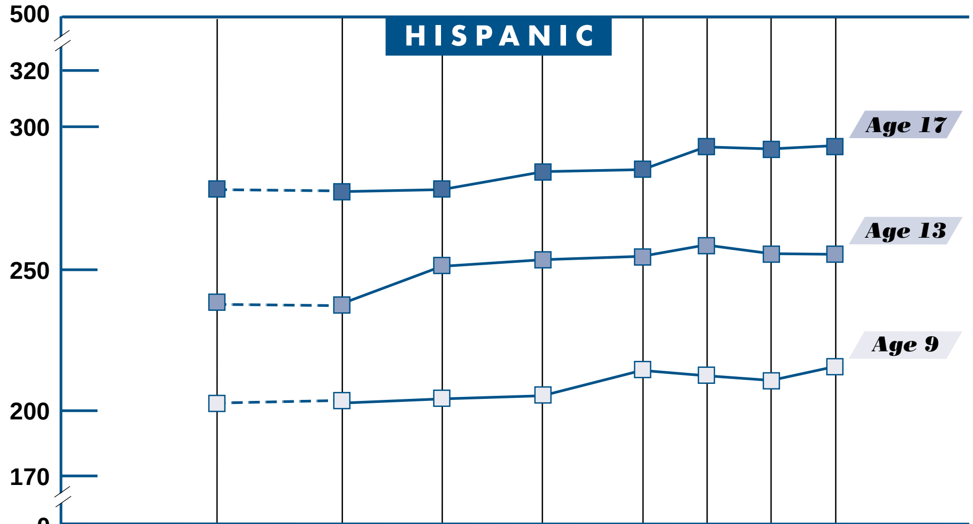
	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	310(1.1) —	306(0.9) 83(1.3)	304(0.9) 81(2.0)	308(1.0) 78(0.5)	310(1.0) 73(0.5)	312(0.8) 75(0.5)	312(1.1) 72(0.5)	313(1.4) 71(0.6)			+	+
Age 13	274(0.9) —	272(0.8) 80(1.7)	274(1.0) 79(2.1)	274(1.3) 77(1.0)	276(1.1) 73(0.7)	279(0.9) 74(0.5)	281(0.9) 73(0.5)	281(0.9) 71(0.6)	+		+	+
Age 9	225(1.0) —	224(0.9) 79(1.4)	224(1.1) 79(2.5)	227(1.1) 77(1.1)	235(0.8) 75(1.1)	235(0.8) 75(0.9)	237(1.0) 75(0.7)	237(1.0) 72(1.1)	+		+	+



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	270(1.3) —	268(1.3) 12(1.1)	272(1.2) 13(1.7)	279(2.1) 14(0.3)	289(2.8) 16(0.3)	286(2.2) 15(0.3)	286(1.8) 16(0.3)	286(1.7) 15(0.3)	+		+	
Age 13	228(1.9) —	230(1.9) 13(1.5)	240(1.6) 14(1.8)	249(2.3) 14(0.9)	249(2.3) 16(0.3)	250(1.9) 16(0.3)	252(3.5) 15(0.3)	252(1.3) 15(0.4)	+		+	–
Age 9	190(1.8) —	192(1.1) 14(1.4)	195(1.6) 14(2.0)	202(1.6) 15(0.5)	208(2.2) 16(0.7)	208(2.0) 16(0.4)	212(1.6) 15(0.5)	212(1.4) 16(0.5)	+		+	

Figure 3.4 (continued)

Trends in Average Mathematics Scale Scores by Race/Ethnicity, 1973 to 1996



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	277(2.2) —	276(2.3) 4(0.5)	277(1.8) 5(1.0)	283(2.9) 6(0.3)	284(2.9) 7(0.4)	292(2.6) 7(0.5)	291(3.7) 9(0.3)	292(2.1) 9(0.7)	+		+	+
Age 13	239(2.2) —	238(2.0) 6(0.9)	252(1.7) 5(1.2)	254(2.9) 7(1.1)	255(1.8) 7(0.5)	259(1.8) 7(0.5)	256(1.9) 8(0.4)	256(1.6) 9(0.7)	+		+	–
Age 9	202(2.4) —	203(2.2) 5(0.7)	204(1.3) 5(1.1)	205(2.1) 6(1.1)	214(2.1) 6(0.6)	212(2.3) 6(0.8)	210(2.3) 6(0.4)	215(1.7) 8(1.0)	+		+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

[– – –] Extrapolated from previous NAEP analyses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1973.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

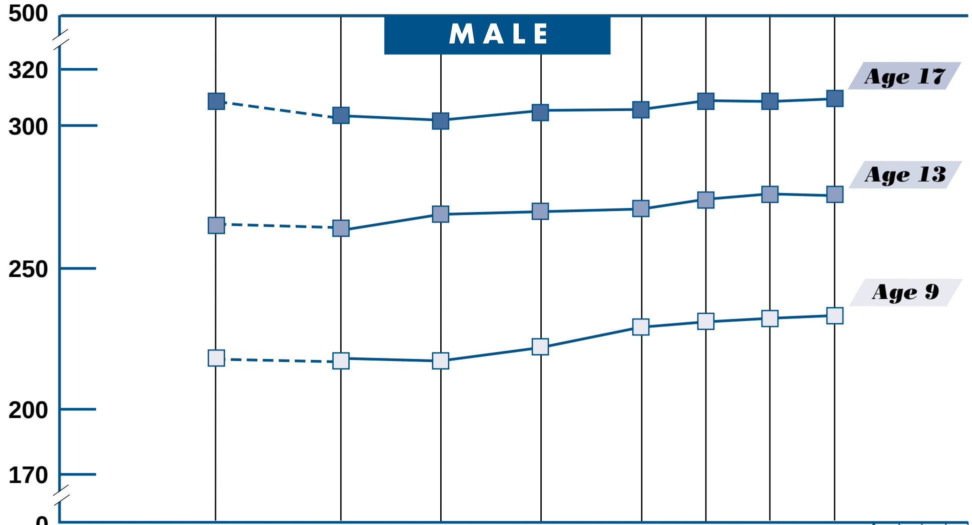
Trends in Mathematics Scale Scores by Gender from 1973 to 1996

Figure 3.5 presents trends in average mathematics scale scores by gender.

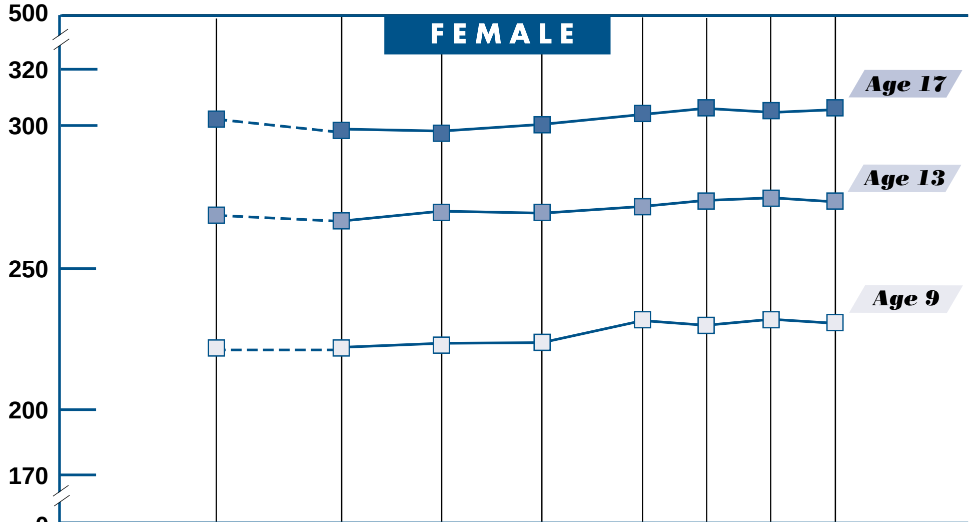
Male Students. During the 1970s and early 1980s, mathematics performance among 17-year-old males declined, but then followed a pattern of increases beginning in 1986. Although the overall pattern of scores showed gains being made, the average score in 1996 was not significantly different from that in 1973. Among 13-year-old males, average scores showed an overall trend of increased performance. Nine-year-old males showed a pattern of stability from 1973 to 1982, followed by score increases in 1986 and 1990, and then small improvements until 1996. The result was a general trend toward higher average scores. For both 9- and 13-year-olds, average mathematics performance in 1996 was above that in 1973.

Female Students. At age 17, female students demonstrated a pattern of declining scores between 1973 and 1982, followed by a recovery period and relative stability in the 1990s. Although the overall trend was positive, the 1996 average score was not significantly different from the 1973 average score. The overall pattern for 13-year-old females showed improvement across the assessment years and resulted in an average score in 1996 that was higher than in 1973. Among female students, the average score for 9-year-olds was relatively consistent through the 1970s and 1980s, then increased in 1990 and has changed little since then. Overall, the pattern was one of improved performance, and the 1996 average score was higher than in 1973.

Figure 3.5 Trends in Average Mathematics Scale Scores by Gender, 1973 to 1996



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	309(1.2) —	304(1.0) 49(0.5)	302(1.0) 49(0.6)	305(1.2) 49(1.2)	306(1.1) 49(0.9)	309(1.1) 51(1.2)	309(1.4) 50(1.3)	310(1.3) 50(1.2)			+	+
Age 13	265(1.3) —	264(1.3) 50(0.5)	269(1.4) 50(0.4)	270(1.1) 50(0.9)	271(1.2) 50(0.6)	274(1.1) 50(0.8)	276(1.3) 49(0.8)	276(0.9) 48(0.8)	+		+	
Age 9	218(0.7) —	217(0.7) 50(0.5)	217(1.2) 49(0.6)	222(1.1) 50(0.6)	229(0.9) 49(0.6)	231(1.0) 49(0.6)	232(1.0) 49(0.8)	233(1.2) 50(0.6)	+		+	+



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	301(1.1) —	297(1.0) 51(0.5)	296(1.0) 51(0.6)	299(1.0) 51(1.2)	303(1.1) 51(0.9)	305(1.1) 49(1.2)	304(1.1) 50(1.3)	305(1.4) 51(1.2)			+	+
Age 13	267(1.1) —	265(1.1) 50(0.5)	268(1.1) 50(0.4)	268(1.5) 50(0.9)	270(0.9) 50(0.6)	272(1.0) 50(0.8)	273(1.0) 51(0.8)	272(1.0) 52(0.8)	+		+	
Age 9	220(1.1) —	220(1.0) 50(0.5)	221(1.2) 51(0.6)	222(1.2) 50(0.6)	230(1.1) 51(0.6)	228(1.0) 51(0.6)	230(0.9) 51(0.8)	229(0.7) 51(0.6)	+		+	+

Below each average scale score, the corresponding percentage of students is presented.
Standard errors of the estimated scale scores and percentages appear in parentheses.
[– – –] Extrapolated from previous NAEP analyses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1973.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Differences in Average Mathematics Scale Scores by Race/Ethnicity and by Gender

The previous sections discussed trends in mathematics achievement for students in different racial/ethnic and gender groups. Previous academic assessments such as NAEP[11] have commonly found higher average achievement in mathematics for White students compared to their minority peer groups. Gender differences have been found less consistently, but tend to favor males in the higher grades. Recent analyses show that this gender gap has been reduced to about one-quarter of what it was 30 years ago.[12]

Some studies have suggested that performance gaps among student groups are due to differential course-taking and dropout rates by gender,[13] and to differences in the opportunities available to students in various racial groups. These differential opportunities include attending effective schools,[14] social and economic factors of the home and school location,[15] and encouragement given to study mathematics.[16]

These factors are consistent with other research that has used NAEP results to explore differences in performance between racial groups.[17] Recent arguments demonstrate that reporting unadjusted differences among racial groups may be misleading since these groups come from different family, school, and community contexts that are related to achievement. When achievement results are controlled for social context, test score differences between groups may be reduced.[18] Other research shows that while a substantial performance gap still exists, the performance difference between non-Hispanic White 13- and 17-year-olds and their Hispanic and Black peers has narrowed between 1975 and 1990. Gains among Black and Hispanic students, however, could not be explained by changing family characteristics (parental education level, family size, family income) alone.[19]

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[11] Campbell, J. R., Reese, C. M., O'Sullivan, C., & Dossey, J. A. (1996). *NAEP 1994 trends in academic progress.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Mullis, I. V. S., Owen, E. H., & Phillips, G. W. (1990). *Accelerating academic achievement: A summary of findings from 20 years of NAEP.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Mullis, I. V. S., Dossey, J. A., Owen, E. H., & Phillps, G. W. (1993). *NAEP 1992 mathematics report card for the nation and the states.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Reese, C. M., Miller, K. E., Mazzeo, J., & Dossey, J. A. (1997). *NAEP 1996 mathematics report card for the nation and the states.* Natoinal Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

[12] Willingham, W. W. & Cole, N. S. (1997). *Gender and fair asssessment.* Mahwah, NJ: Lawrence Erlbaum Associates.

[13] Meyer, M. (1989). Gender differences in mathematics. In M. M. Lindquist (Ed.), *Results from the fourth mathematics assessment of the NAEP.* Reston, VA: National Council of Teachers of Mathematics.

[14] Mullis, I. V. S., Jenkins, F., & Johnson, E. G. (1994). *Effective schools in mathematics.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

[15] Oakes, J. (1990). *Multiplying inequalities: The effects of race, social class, and tracking on opportunities to learn mathematics and science.* Santa Monica, CA: RAND.

[16] Backer, A., & Akin, S. (Eds.). (1990). *Every child can succeed: Readings for school improvement.* Bloomington, IN: Agency for Instructional Television.

[17] Berends, M., & Koretz, D. M. (1995). Reporting minority students' test scores: How well can the National Assessment of Educational Progress account for differences in social context? *Educational Assessment, 3*(3), 249-285.

Jaynes, G. D., & Williams, R. M. Jr. (Eds.). (1989). *A common destiny: Blacks and American society.* Washington, DC: National Academy Press.

Grissmer, D. W., Kirby, S. N., Berends, M., & Williamson, S. (1994). *Student achievement and the changing American family.* Santa Monica, CA: Rand.

[18] Berends, M., & Koretz, D. M. op. cit.

[19] Grissmer, D. W., et. al., op. cit.

The size of the gap between various student groups and the changes in these differences over time are matters of considerable public interest. Trends in score differences help shed light on whether the performance gaps between racial/ethnic and between gender groups are increasing, decreasing, or staying the same. As with past NAEP assessments, significant differences were observed in the long-term trend mathematics assessment between racial/ethnic groups and between males and females. Trends in the differences between the average mathematics scores of selected subgroups of students across the assessments are displayed in Figure 3.6.

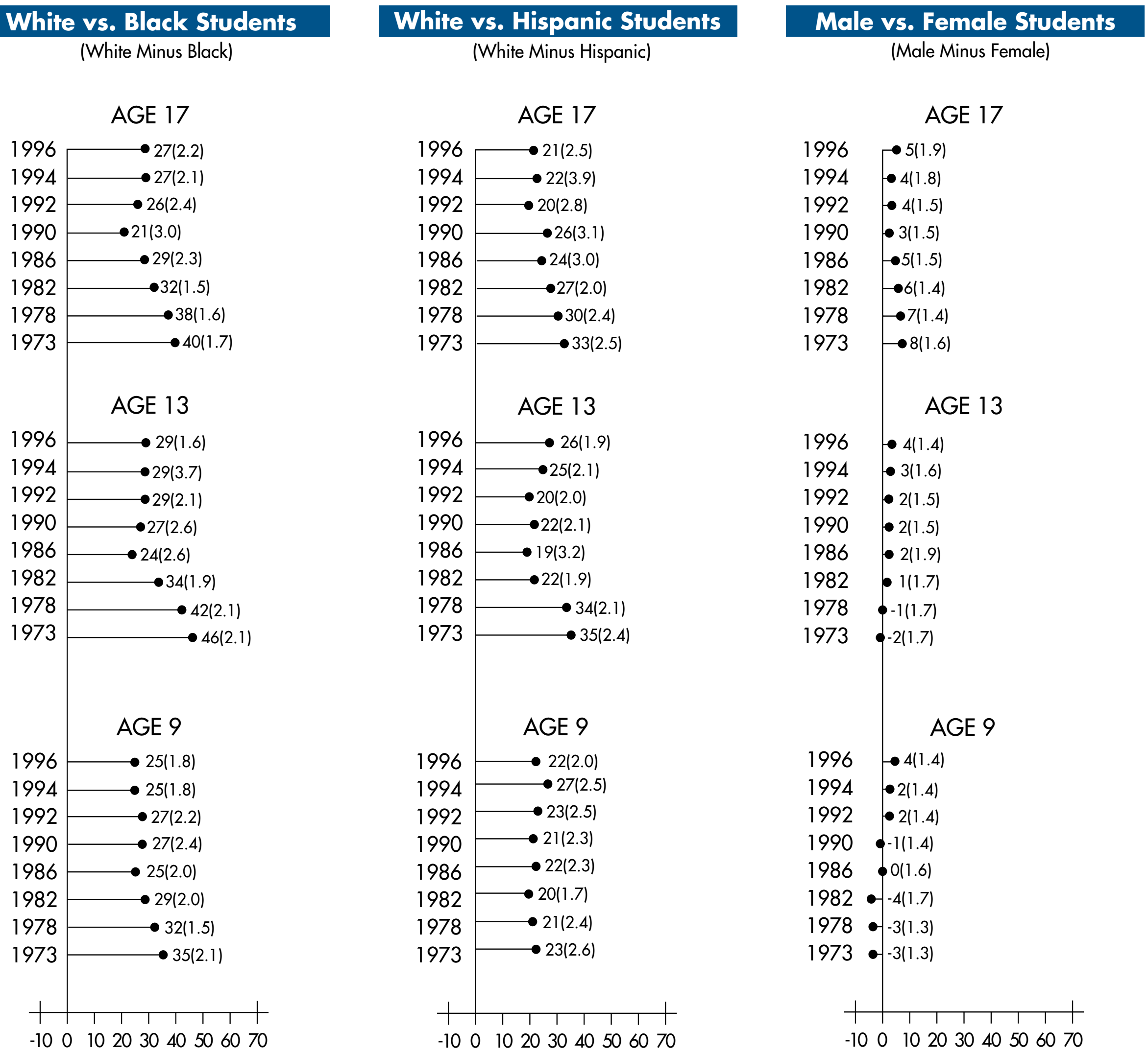
White-Black. In 1996, the average scores of 9-, 13-, and 17-year-old White students were higher than the average scores of their Black peers. At age 17, the gap between White and Black students narrowed during the 1970s and 1980s. Although there was some evidence of widening gaps in the 1990s, the overall trend has been toward smaller gaps and, the size of the gap in 1996 was smaller than in 1973. This trend was the result of an average gain among Black students between 1973 and 1990, and somewhat stable scores during the 1990s. This stands in contrast to White 17-year-olds whose average scores fluctuated slightly between 1973 and 1990, and then increased slightly. Similar to the results for 17-year-olds, the gap between scores of White and Black 13-year-olds narrowed during the 1970s and 1980s, but has widened somewhat since that time. Nevertheless, the overall trend has been toward smaller gaps, and the size of the difference between White and Black average performance was smaller in 1996 than in 1973. This trend in score gaps may be attributed to gains made by Black 13-year-olds from 1973 to 1986, while the scores for White 13-year-olds remained somewhat stable. At age 9, the gap between White and Black students' scores generally decreased across the assessment years, and in 1996 it was smaller than the gap observed in 1973. This narrowing of the gap was the result of increases in average scores among Black students from 1973 to 1986, while the average scores of White students remained relatively stable during the same time period.

White-Hispanic. In 1996, White students outperformed Hispanic students in mathematics at all three ages. Among 17-year-olds, the overall trend shows decreasing differences between White and Hispanic students across the assessment years. The magnitude of the gap in 1996 was smaller than in 1973. At age 13, the differences between the average scores for White and Hispanic students declined until 1986 and widened somewhat in the 1990s. The overall trend was one of narrowing gaps, and the difference in average scores between White and Hispanic 13-year-olds in 1996 was smaller than in 1973. This trend resulted from average score gains among Hispanics from 1973 to 1986, while average scores for Whites remained stable during this time period. Since 1986, the average score of White 13-year-olds has increased, but the average for their Hispanic peers has remained somewhat stable. The gap between White and Hispanic 9-year-olds has remained relatively stable across the assessment years from 1973 to 1996.

Male-Female. At all three ages in 1996, male students outscored females in mathematics. The overall trend among 17-year-olds showed a narrowing of the gap, with the male advantage lessening over the years. Despite this general pattern of decreasing differences, the gender gap in 1996 was not significantly different from that in 1973. Trend analyses of the mathematics score gaps between male and female students aged 9 and 13 revealed a small, but significant shift across time. At both ages, the trend has been away from higher average scores for female students toward higher average scores for male students. However, in most of the assessment years, the average score difference between male and female students was not significant.

Figure 3.6

Trends in Differences in Average Mathematics Scale Scores by Race/Ethnicity and Gender



White vs. Black Students

	*	‡	L	Q
Age 17	–		–	+
Age 13	–		–	+
Age 9	–		–	

White vs. Hispanic Students

	*	‡	L	Q
Age 17	–		–	
Age 13	–		–	+
Age 9				

Male vs. Female Students

	*	‡	L	Q
Age 17			–	
Age 13	+		+	
Age 9	+		+	

Standard errors of the estimated scale score differences appear in parentheses.
* Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1973.
‡ Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Mathematics Scale Scores by Region from 1973 to 1996

Figure 3.7 shows trends in average mathematics scale scores for each of four geographic regions of the country: Northeast, Southeast, Central, and West. These data reveal the changes that have occurred in the last 23 years for students in different areas of the country, demonstrating whether overall gains or losses in mathematics performance were similar for different geographic regions.

Northeast. Among 17-year-olds in the Northeast, average scores declined between 1973 and 1982, and then changed little until 1992 when some increase was observed. The 1996 average score for these students was not significantly different from the average in 1973. With the exception of a score increase in 1994, the overall performance of 13-year-olds has been relatively consistent across the assessment years. The 1996 average score for these students was lower than that in the previous assessment in 1994, but not significantly different from the average in 1973. Nine-year-olds showed a trend of stable performance from 1973 to 1986, followed by an increase in 1990. The overall trend for this age group was one of improved performance, and the 1996 average score was higher than in 1973.

Southeast. In the Southeast, overall improvement was observed for 9-, 13-, and 17-year-olds across the assessment years. For 17-year-olds, the pattern was one of declines in performance followed by increasing scores. For all three age groups, average scores in 1996 were improved over 1973 averages.

Central. For both 9- and 17-year-olds in the Central region, average scores declined slightly during the 1970s and early 1980s, then increased, resulting in an overall pattern of increased performance and higher scores in 1996 than in 1973. Additionally, 17-year-olds showed improvement in 1996 over the previous assessment in 1994. Despite some fluctuations, the overall trend for 13-year-olds indicates improved performance across the assessment years, resulting in an average score in 1996 that was higher than the 1973 average.

West. The performance of 17-year-olds in the West declined from 1973 to 1982, recovered somewhat in 1986, and has increased slowly since that time. Although the overall trend was positive, the average score in 1996 did not differ significantly from that in 1973. Overall improvement was observed for 9- and 13-year-olds. For both groups, average scores in 1996 were higher than those in 1973.

Comparisons of 1996 average mathematics scores for the four regions revealed several differences. At age 9, students in the Northeast had higher average scores than students in the Southeast and Western regions. At ages 13 and 17, students in the Central region outscored their peers in the Southeast and West.

Figure 3.7 Trends in Average Mathematics Scale Scores by Region, 1973 to 1996

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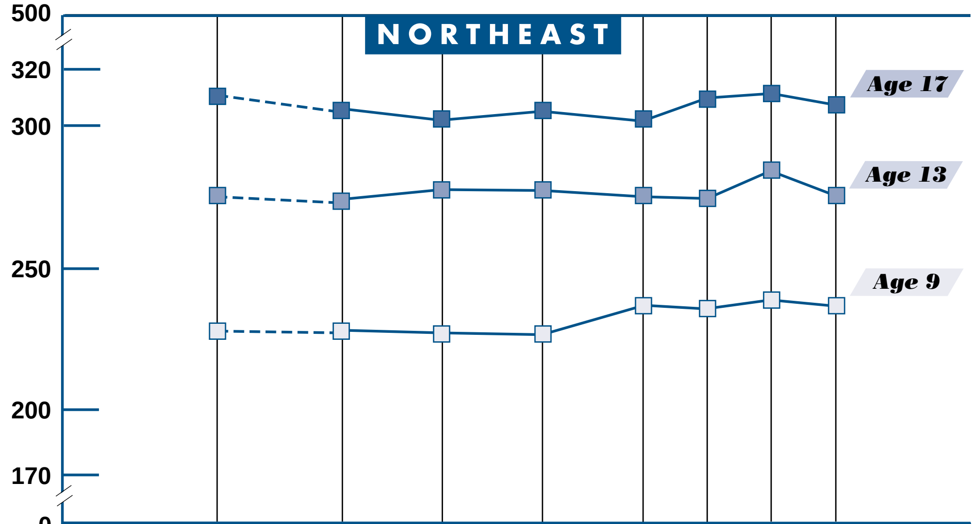
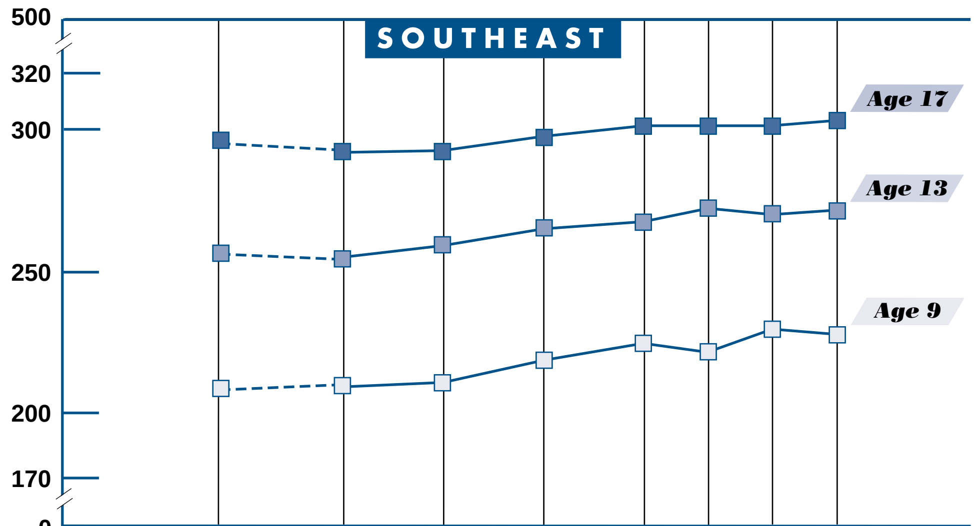
NORTHEAST



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	312(1.8) —	307(1.8) 23(2.0)	304(2.0) 24(2.8)	307(1.9) 24(0.8)	304(2.1) 22(1.0)	311(2.0) 22(0.9)	313(2.9) 23(1.0)	309(3.0) 23(2.7)				+
Age 13	275(2.4) —	273(2.4) 23(2.2)	277(2.0) 24(2.5)	277(2.2) 22(1.6)	275(2.3) 24(1.0)	274(2.2) 21(0.8)	284(1.5) 20(0.9)	275(2.1) 22(2.0)		–		
Age 9	227(1.9) —	227(1.9) 22(2.5)	226(1.8) 21(2.7)	226(2.7) 21(1.1)	236(2.1) 23(0.9)	235(1.9) 21(1.2)	238(2.2) 22(0.9)	236(2.0) 22(2.3)	+		+	+

SOUTHEAST



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	296(1.8) —	292(1.7) 22(2.1)	292(2.1) 20(2.1)	297(1.4) 23(2.3)	301(2.3) 24(0.9)	301(1.9) 25(1.4)	301(1.6) 25(1.5)	303(2.1) 22(2.9)	+		+	+
Age 13	255(3.2) —	253(3.3) 23(2.0)	258(2.2) 23(2.2)	264(1.4) 25(5.8)	266(1.9) 23(0.8)	271(2.5) 24(1.6)	269(2.0) 22(1.7)	270(1.8) 25(2.6)	+		+	
Age 9	208(1.3) —	209(1.2) 24(2.1)	210(2.5) 24(2.7)	218(2.5) 23(4.7)	224(2.4) 24(0.9)	221(1.7) 24(1.3)	229(1.4) 24(1.5)	227(2.0) 23(2.6)	+		+	

Figure 3.7 (continued)

Trends in Average Mathematics Scale Scores by Region, 1973 to 1996

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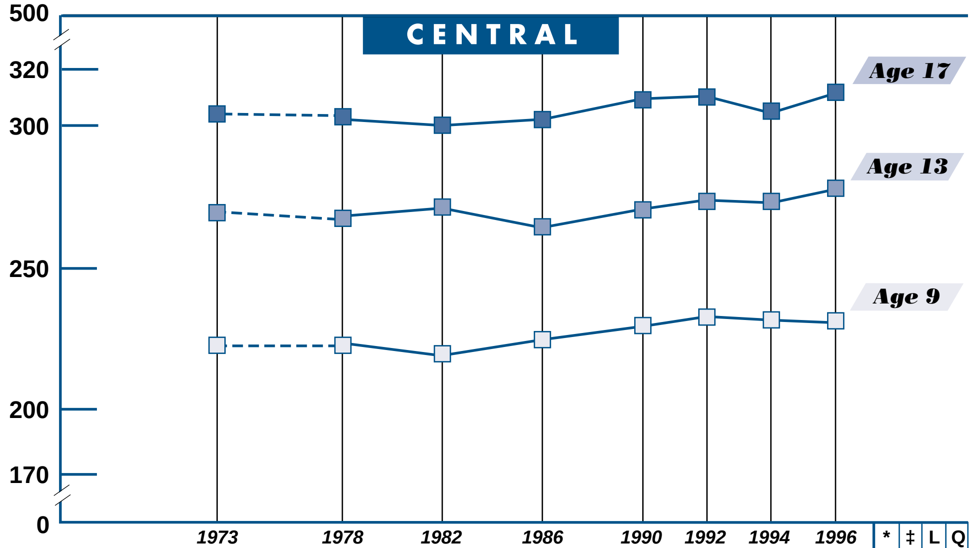
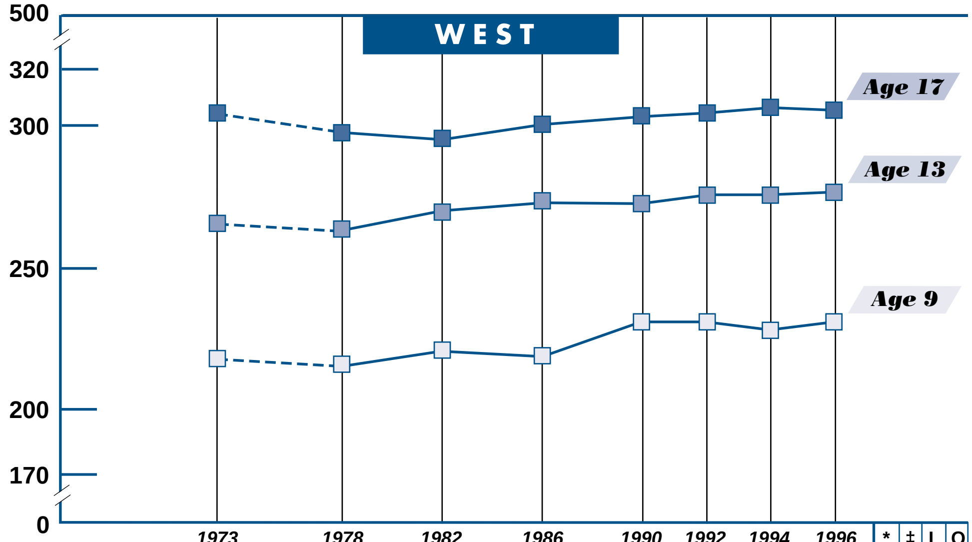


	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	306(1.8) —	305(1.9) 31(2.1)	302(1.4) 30(4.3)	304(1.9) 28(2.2)	311(2.1) 26(0.9)	312(2.0) 25(1.0)	307(2.2) 26(1.1)	314(2.0) 25(0.9)	+	+	+	+
Age 13	271(1.8) —	269(1.8) 31(1.8)	273(2.1) 27(3.4)	266(4.5) 25(5.0)	272(2.4) 24(0.7)	275(1.5) 27(1.0)	275(3.4) 27(1.8)	280(1.3) 23(1.0)	+		+	+
Age 9	224(1.5) —	224(1.5) 31(1.8)	221(2.7) 28(3.8)	226(2.3) 29(4.0)	231(1.3) 24(0.6)	234(1.6) 28(0.8)	233(1.8) 26(1.0)	233(2.3) 25(0.9)	+		+	+



	1973	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	303(2.0) —	296(1.8) 23(2.5)	294(1.9) 26(2.8)	299(2.7) 26(0.9)	302(1.5) 28(0.9)	303(1.5) 29(0.9)	305(2.4) 27(1.0)	304(2.3) 30(2.3)			+	+
Age 13	262(1.9) —	260(1.9) 24(2.2)	266(2.4) 27(2.3)	270(2.1) 28(1.5)	269(1.6) 29(0.9)	272(1.4) 29(0.9)	272(1.7) 31(1.1)	273(1.9) 30(1.9)	+		+	
Age 9	216(2.2) —	214(1.3) 23(2.0)	219(1.8) 27(2.0)	217(2.4) 28(1.6)	229(1.8) 28(0.8)	229(2.3) 27(0.8)	226(1.6) 28(1.0)	229(1.3) 30(2.6)	+		+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

[– – –] Extrapolated from previous NAEP analyses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1973.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Mathematics Scale Scores by Parents' Highest Level of Education from 1978 to 1996

A consistent predictor of student achievement is the education level of the parents.[20] Presented in Figure 3.8 are trend results from 1978 to 1996 in average mathematics scores by parents' highest level of education. (Note that results by parental education level are not available for extrapolated data.) For all three age groups, students reported higher levels of parental education in 1996 than in 1978. For example, higher percentages reported having at least one parent who had graduated from college. Also, a lower percentage reported that neither parent had graduated from high school, or that high school graduation was their parents' highest level of educational attainment. It should be noted that across the trend assessments, approximately one-third of 9-year-olds and one-tenth of 13-year-olds responded "I don't know" to the question about their parents' highest level of education. Furthermore, some research has revealed the potential for young children to provide inaccurate reports about such information.[21]

In 1996, specific comparisons of mathematics scores were made between groups of students with different levels of parental education. In general, higher average scores were found for students who reported higher levels of parental education. These results were consistent for all age groups with only two exceptions: among 9-year-olds, no significant score differences were found between students with parents whose highest education level was high school graduation and students whose parents did not graduate from high school, or between students with at least one parent who had graduated from college and students whose parents' highest education level was some education beyond high school.

Among 17-year-olds, the average scores of students at each of the four levels of parental education have shown no consistent pattern of increases or decreases across the assessment years. For all four groups of 17-year-olds, average scores in 1996 were not significantly different from average scores in 1978.

At age 13, students who reported that neither parent had graduated from high school demonstrated an overall pattern of increasing scores resulting in an average score in 1996 that was higher than the average in 1978. A pattern of overall improvement was also observed for 13-year-olds with at least one parent who had received some education after high school and for students who reported high school graduation as their parents' highest level of education. However, the 1996 average scores for these two groups of students was not significantly different from those in 1978. For 13-year-olds who reported college graduation as their parents' highest level of education, no overall trend in average mathematics scores was observed, and the average score in 1996 did not significantly differ from the 1978 average.

For 9-year-olds at all reported levels of parental education, a pattern of overall improvement was observed across the assessment years. At the lowest and highest parental education levels, this overall pattern resulted in a 1996 average score that was higher than that in 1978.

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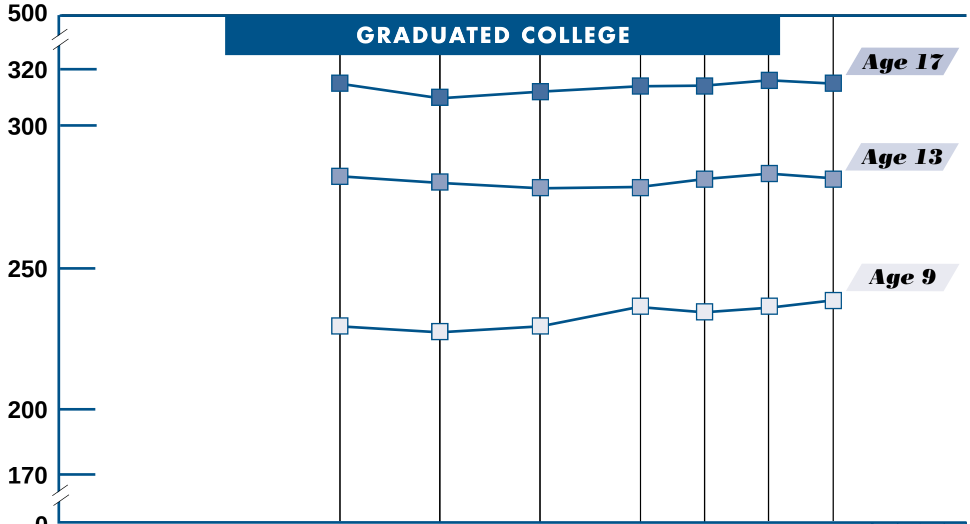
[20] National Center for Education Statistics (1990). *A profile of the American eighth grader: NELS:88 student descriptive summary* (NCES 90-458). Washington, DC: U.S. Department of Education.

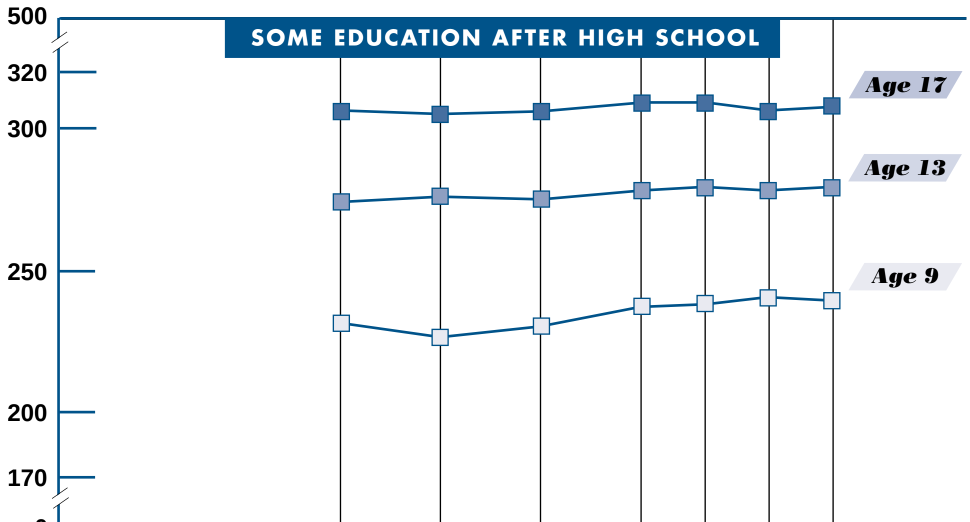
Reese, C. M., Miller, K. E., Mazzeo, J., & Dossey, J. A. (1997). *NAEP 1996 mathematics report card for the nation and the states.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

[21] Looker, E. D. (1989). Accuracy of proxy reports of parental status characteristics. *Sociology of Education, 62*(4), 257-276.

Figure 3.8	Trends in Average Mathematics Scale Scores by Parents' Highest Level of Education, 1978 to 1996	THE NATION'S REPORT CARD naep



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	317(1.0) 32(1.1)	312(1.0) 32(1.3)	314(1.4) 37(1.2)	316(1.3) 39(1.4)	316(1.0) 43(1.4)	318(1.4) 44(1.5)	317(1.3) 46(1.5)				
Age 13	284(1.2) 26(1.2)	282(1.5) 32(1.3)	280(1.4) 38(2.0)	280(1.0) 41(1.2)	283(1.0) 44(1.3)	285(1.2) 46(1.3)	283(1.2) 45(1.6)				
Age 9	231(1.1) 24(1.1)	229(1.5) 30(1.5)	231(1.1) 38(1.1)	238(1.3) 40(1.1)	236(1.0) 42(1.2)	238(0.8) 45(0.8)	240(1.4) 43(1.2)	+		+	

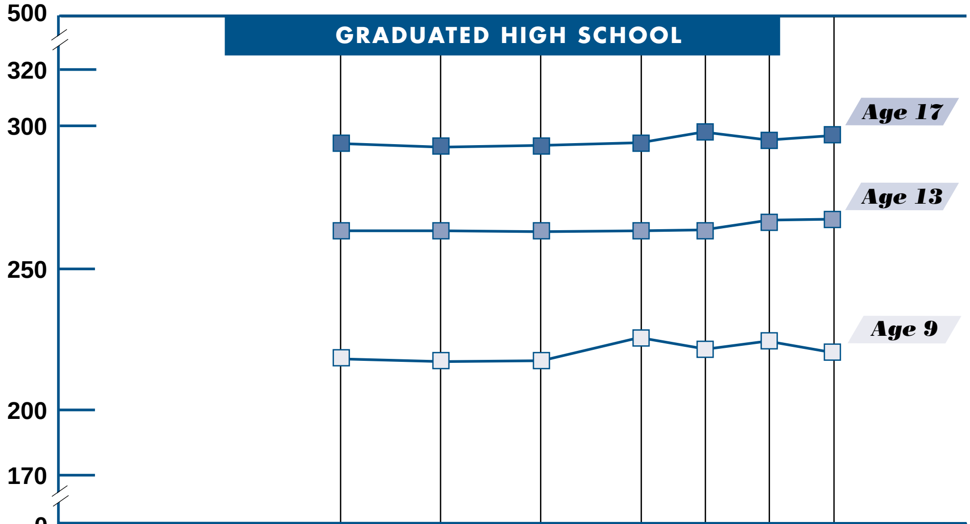


	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	305(0.9) 16(0.4)	304(0.9) 18(0.5)	305(1.2) 24(1.0)	308(1.0) 24(0.9)	308(1.1) 25(0.9)	305(1.3) 24(1.1)	307(1.5) 24(1.1)				
Age 13	273(1.2) 14(0.4)	275(0.9) 14(0.4)	274(0.8) 16(0.6)	277(1.0) 17(0.6)	278(1.0) 18(0.7)	277(1.6) 17(0.6)	278(1.4) 17(0.5)			+	
Age 9	230(1.7) 9(0.4)	225(2.1) 9(0.4)	229(2.1) 7(0.6)	236(2.0) 7(0.4)	237(1.9) 8(0.4)	239(2.1) 7(0.4)	238(2.5) 7(0.4)			+	

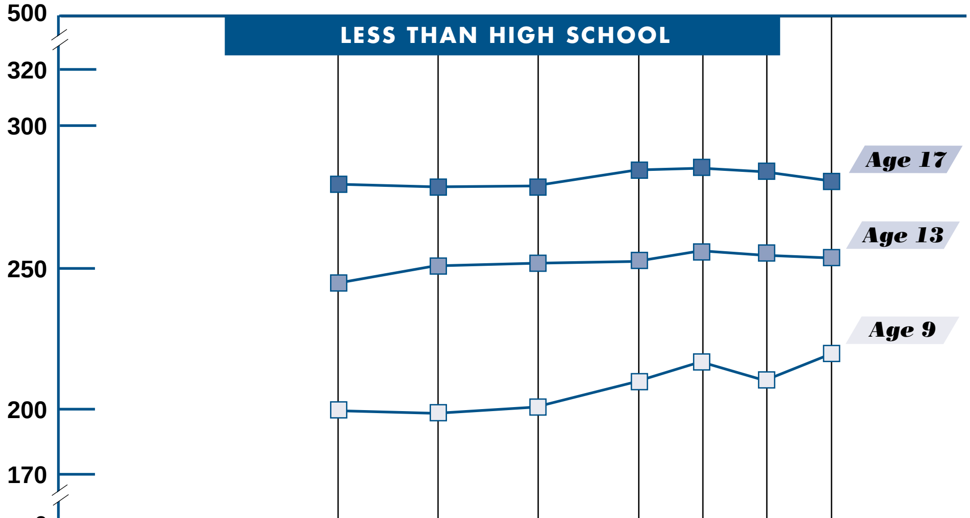
Figure 3.8 (continued)

Trends in Average Mathematics Scale Scores by Parents' Highest Level of Education, 1978 to 1996

THE NATION'S REPORT CARD naep



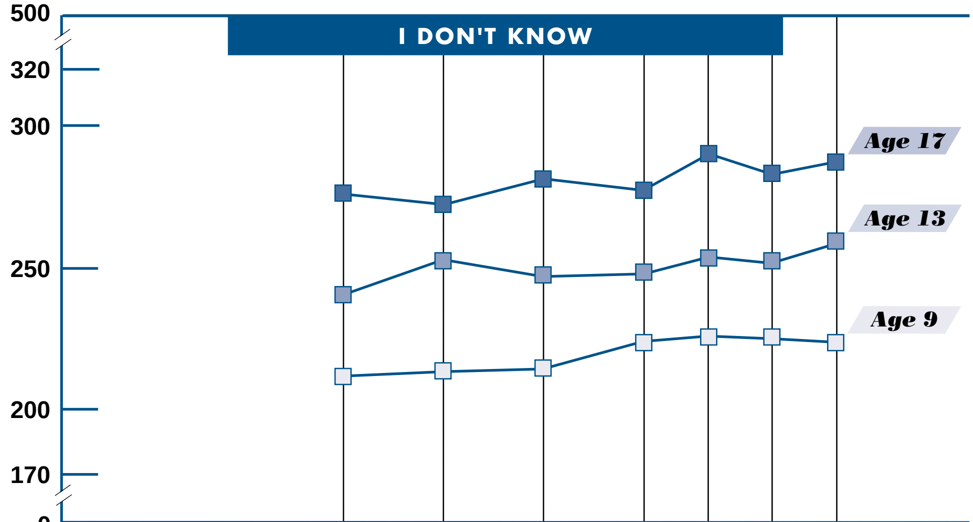
	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	294(0.8) 33(0.7)	293(0.8) 33(0.8)	293(1.0) 28(1.1)	294(0.9) 26(1.1)	298(1.7) 21(0.9)	295(1.1) 22(0.8)	297(2.4) 21(1.1)				
Age 13	263(1.0) 33(0.8)	263(0.8) 34(0.8)	263(1.2) 31(1.3)	263(1.2) 27(0.8)	263(1.2) 23(0.9)	266(1.1) 23(0.9)	267(1.1) 23(1.0)			+	
Age 9	219(1.1) 23(0.8)	218(1.1) 25(0.8)	218(1.6) 16(0.7)	226(1.2) 16(0.7)	222(1.5) 14(0.7)	225(1.3) 14(0.6)	221(1.7) 13(0.6)			+	



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	280(1.2) 13(0.6)	279(1.0) 14(0.9)	279(2.3) 8(0.4)	285(2.2) 8(0.6)	286(2.3) 8(0.6)	284(2.4) 7(0.5)	281(2.4) 6(0.7)				
Age 13	245(1.2) 12(0.6)	251(1.4) 11(0.6)	252(2.3) 8(1.1)	253(1.8) 8(0.5)	256(1.0) 6(0.5)	255(2.1) 6(0.4)	254(2.4) 6(0.4)	+		+	
Age 9	200(1.5) 8(0.4)	199(1.7) 8(0.7)	201(2.5) 4(0.4)	210(2.3) 5(0.4)	217(2.2) 4(0.3)	210(3.0) 4(0.4)	220(3.3) 4(0.5)	+		+	

Figure 3.8 (continued)

Trends in Average Mathematics Scale Scores by Parents' Highest Level of Education, 1978 to 1996



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	276(1.9) 5(0.4)	272(1.8) 4(0.3)	281(2.4) 3(0.3)	277(2.8) 3(0.4)	290(3.9) 3(0.3)	283(3.8) 3(0.3)	287(4.0) 2(0.2)			+	
Age 13	240(1.3) 15(0.9)	252(3.2) 9(0.8)	247(2.3) 8(0.4)	248(2.1) 8(0.5)	253(1.8) 8(0.4)	252(2.4) 8(0.5)	259(1.4) 10(0.6)	+		+	
Age 9	211(1.1) 37(1.5)	213(1.5) 27(1.1)	214(1.4) 35(1.0)	223(1.0) 32(0.8)	225(1.0) 33(0.8)	225(1.1) 30(0.8)	223(1.0) 33(0.9)	+		+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1978.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Mathematics Scale Scores by Type of School from 1978 to 1996

In recent years, there has been considerable interest in comparing the educational quality of public and nonpublic schools. The public vs. private school debate was fueled about a decade ago by a major report concluding that private school students had higher mathematics and verbal achievement than their public school peers.[22] Previous large-scale assessments including NAEP have found higher mathematics achievement among students attending nonpublic schools compared to those in public schools.[23] The NAEP trend assessment results permit a comparison between the performance of students attending public and nonpublic schools. (Results by type of school are not available for extrapolated data.) However, inferences about the relative effectiveness of public and nonpublic schools should not be solely based on NAEP results. Average performance differences between the two types of schools may be related to socioeconomic and sociological factors such as per-pupil expenditures, academic curricula, course-taking patterns, disciplinary climate, and the level of parental involvement in students' education.[24] Some research has shown that the mathematics achievement of public and nonpublic school students may be statistically equivalent when factors such as school climate, parental support, and course work are held constant.[25]

Figure 3.9 presents trend data on the percentages of students attending public and nonpublic schools and their corresponding mathematics scale scores. The percentages of students enrolled in the two types of schools have remained relatively stable over time. In 1996, the approximate percentages of 9-, 13-, and 17-year-olds attending public schools were 87, 89, and 91 percent, respectively. In 1996, 9- and 13-year-olds attending nonpublic schools had higher average scores than their public school peers. Although the observed scores were in the same direction for 17-year-olds, the difference was not statistically significant.

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22 Coleman, J. S., Hoffer, T., & Kilgore, S. (1982). *High school achievement: Public, Catholic, and private schools compared.* Basic Books.

National Center for Education Statistics (1995). *National education longitudinal study of 1988: Base year student survey.* Washington, DC.

23 Campbell, J. R., Reese, C. M., O'Sullivan, C., & Dossey, J. A. (1996). *NAEP 1994 trends in academic progress.* National Center for Education Statistics. Washington, DC: U. S. Government Printing Office.

24 Alexander, K. L., & Pallas, A. M. (1983). Private schools and public policy: New evidence on cognitive achievement in public and private schools. *Sociology of Education, 56*, 170-182.

Berliner, D., & Biddle, B. (1996). In defense of schools. *Vocational Education Journal, 71*(3), 36-38.

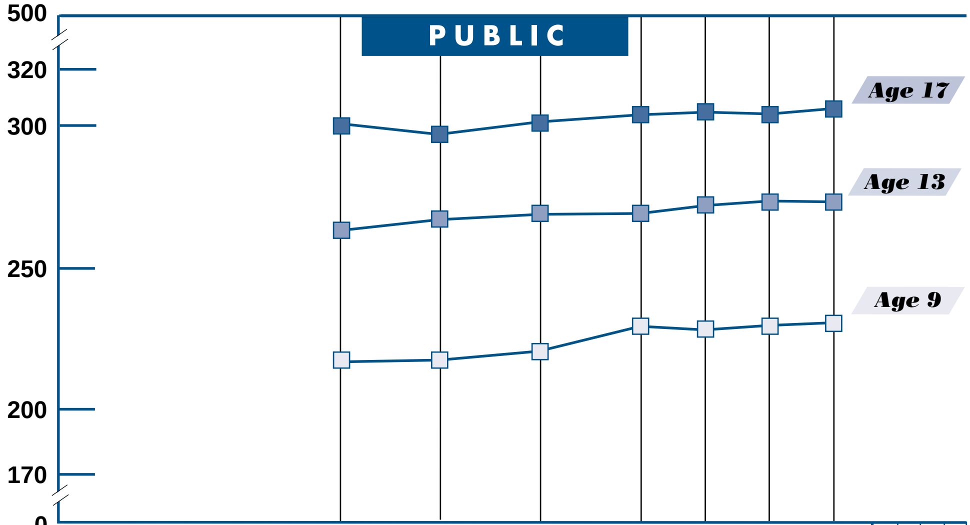
25 Mullis, I.V.S., Jenkins, F., & Johnson, E. G. (1994). *Effective schools in mathematics: Perspectives from the NAEP 1992 assessment.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Public School Students. The average mathematics scores of public school students at all three ages indicated an overall pattern of increased performance from 1978 to 1996. For each age group, the positive linear trend resulted in an average score in 1996 that was higher than the average in 1978.

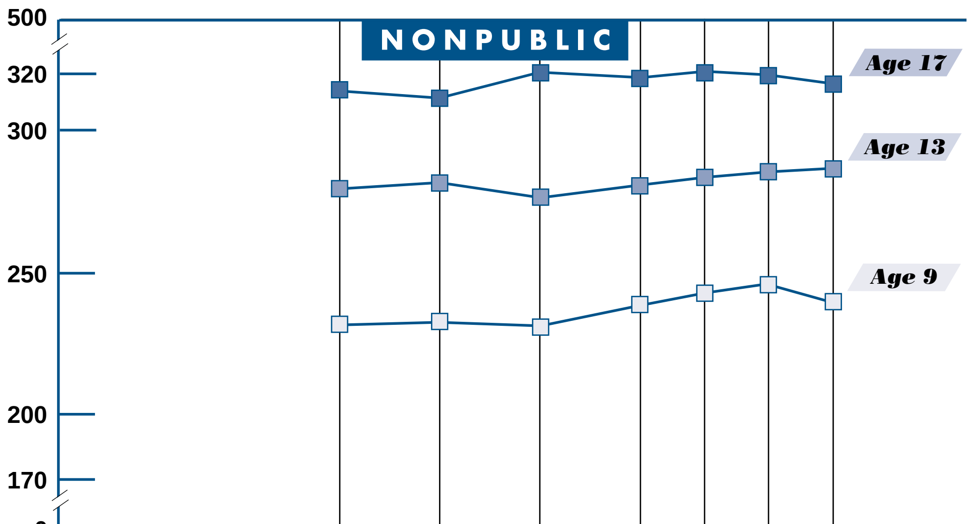
Nonpublic School Students. Despite some fluctuations, no significant trend across the assessment years was observed for 17-year-old nonpublic school students. There was no significant difference between the 1978 and 1996 average scores for this group of students. Thirteen-year-olds attending nonpublic schools exhibited an overall pattern of improved performance. However, the 1996 average score for these students was not significantly different than the 1978 average. Among nonpublic school students, the performance of 9-year-olds improved across the assessment years and resulted in an average score in 1996 that was higher than the average score in 1978.

Figure 3.9

Trends in Average Mathematics Scale Scores by Type of School, 1978 to 1996



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	300(1.0) 94(1.0)	297(0.9) 92(1.6)	301(1.0) 96(1.4)	304(0.8) 93(1.8)	305(0.9) 91(2.2)	304(0.9) 88(2.3)	306(1.1) 91(1.7)	+		+	
Age 13	263(1.2) 91(1.6)	267(1.3) 89(1.3)	269(1.2) 96(1.8)	269(1.0) 90(1.4)	272(1.0) 88(1.9)	273(1.1) 88(1.7)	273(0.9) 89(1.8)	+		+	
Age 9	217(0.8) 89(1.8)	217(1.1) 87(2.2)	220(1.2) 84(2.7)	229(0.9) 89(2.1)	228(0.9) 87(1.6)	229(0.9) 88(1.8)	230(0.8) 87(1.5)	+		+	



	1978	1982	1986	1990	1992	1994	1996	*	‡	L	Q
Age 17	314(3.2) 6(1.0)	311(1.7) 8(1.6)	320(9.8) 4(1.4)	318(6.6) 7(1.8)	320(3.0) 9(2.2)	319(4.0) 12(2.3)	316(4.5) 9(1.7)				
Age 13	279(1.4) 9(1.6)	281(2.1) 11(1.3)	276(4.9) 4(1.8)	280(1.7) 10(1.4)	283(2.5) 12(1.9)	285(2.4) 12(1.7)	286(3.6) 11(1.8)			+	
Age 9	231(1.7) 11(1.8)	232(2.1) 14(2.2)	230(2.5) 16(2.7)	238(2.3) 11(2.1)	242(1.7) 13(1.6)	245(2.3) 12(1.8)	239(2.1) 13(1.5)	+		+	

Below each average scale score, the corresponding percentage of students is presented.
Standard errors of the estimated scale scores and percentages appear in parentheses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1978.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Summary

- The overall picture of mathematics achievement provided by the long-term trend results is one of early stability or declines followed by a pattern of increased performance. For 9-year-olds, scores remained stable from 1973 to 1982, but have increased since that time. The average score in 1996 was higher than that in 1973. For 13-year-olds, a pattern of improvement across the years resulted in a 1996 score that was higher than in 1973. For 17-year-olds, the increased performance observed after a period of decline from 1973 to 1982 has resulted in an average score in 1996 that did not differ significantly from that in 1973.

- The percentage of 9-year-olds students attaining at least Levels 150, 200, 250, and 300 on the mathematics scale in 1996 was higher than in 1978. Increased percentages were observed for 13-year-olds at or above Levels 200 and 250. At age 17, there were increases between 1978 and 1996 in the percentages of students who performed at or above Levels 250 and 300.

- Although there were slight variations, 9-, 13-, and 17-year-olds in the upper, middle two and lower quartiles of the performance distribution demonstrated an overall pattern of increasing scores across the assessment years. For each age group in each quartile, these gains resulted in average scores in 1996 that were higher than those in 1978.

- For White students aged 9 and 13, average scores increased overall across the assessment years resulting in 1996 averages that were higher than those in 1973. Although an overall gain was indicated by the trend analysis of White 17-year-olds' average scores, the average in 1996 was not significantly different from that in 1973. For Black students at all three ages, significant gains have been made in mathematics across the assessment years, and average scores in 1996 were higher than in 1973. Despite some fluctuations, Hispanic students in each age group demonstrated overall gains and attained average scores in 1996 that were higher than those of their counterparts in 1973.

- In 1996, White students outperformed their Black and Hispanic peers at each grade level. At age 9, the gap between White and Black students' mathematics performance decreased across the assessment years, and in 1996, it was lower than it had been in 1973. At ages 13 and 17, the performance gap between White and Black students decreased during the 1970s and most of the 1980s. Since that time, there is evidence that the gap has widened; however, the difference in 1996 was of a smaller magnitude than that in 1973. The gap between White and Hispanic 9-year-olds has remained relatively stable across the assessment years. At ages 13 and 17, there has been a general narrowing of the gap between White and Hispanic students' average scores across the assessments. Although the gap for 13-year-olds appears to have widened somewhat in recent assessments, the differences between White and Hispanic students' performance at ages 13 and 17 were smaller in 1996 than in 1973.

- Both male and female students aged 9 and 13 showed overall gains across the eight assessments, resulting in 1996 average scores that were higher than the 1973 averages. After a period of declining performance from 1973 to 1982, the averages scores of male and female 17-year-olds increased moderately. Although the overall pattern for these students was one of increased performance, there was no significant difference between the 1996 and 1973 average scores.

- In 1996, male students outperformed their female peers in each age group. At ages 9 and 13, trend analyses revealed a small, but significant shift across time: although female students tended to have higher average scores than their male peers in earlier assessment years, it has reversed in more recent years, so that male students now perform higher. At age 17, where male students have attained higher average scores than their female peers in each of the eight assessments, the pattern is one of narrowing gender gaps across the assessment years. However, the magnitude of the gap in 1996 was not significantly different from that in 1973.
- In the Northeast, a period of relatively stable performance for 9-year-olds during the 1970s and 1980s was followed by a period of increasing scores, resulting in a 1996 average score that was higher than the 1973 average. Although the average score of 13-year-olds in the Northeast increased between 1992 and 1994, a decrease between 1994 and 1996 has returned the average score for these students to a level not significantly different from that in 1973. Among 17-year-olds in the Northeast, average scores have recovered during the 1990s, after declining in the 1970s and remaining relatively stable in 1980s. However, the 1996 average score for these students did not differ significantly from that in 1973. In the Southeast, overall improvement was observed for 9-, 13-, and 17-year-olds across the assessment years, resulting in 1996 average scores that were higher than those in 1973. In the Central region, students at all three ages displayed gains since the 1980s, resulting in an overall pattern of improved performance and average scores in 1996 that were higher than those in 1973. In the West, both 9- and 13-year-olds demonstrated overall improvement and attained average scores in 1996 that were higher than those of their counterparts in 1973. Although 17-year-olds in the West have also shown overall improvement, the 1996 average score was not significantly different than the 1973 average.
- At age 9, students in the Northeast had higher average scores than their peers in the Southeast and the West. At ages 13 and 17, students in the Central region outperformed their peers in the Southeast and West.
- For all three age groups, higher percentages of students in 1996 than in 1978 reported that at least one parent had graduated from college. Nine-year-old students at each level of parental education displayed a pattern of overall improvement. However, the 1996 average score was higher than the 1978 average only for 9-year-olds who reported that at least one parent had graduated from college, or that neither parent had completed high school. An overall improvement was also indicated by the trend analyses of average scores for 13-year-old students at each level of parental education except the highest. However, the 1996 average score was significantly higher than the 1978 average only for 13-year-olds who reported that neither parent had completed high school. No overall trend or significant difference between assessment years was apparent in the average scores of 17-year-old students at any level of parental education.

- In 1996, the average scores of 9- and 13-year-old students attending nonpublic schools was higher than that of their peers attending public schools. The difference between 17-year-old public and nonpublic school students' average scores was not significantly different. Among public school students, the average scores of 9-, 13-, and 17-year-old students displayed overall gains across the assessment years, resulting in 1996 average scores that were higher than the 1978 averages. Among nonpublic school students, the performance of 9-year-olds improved across the assessment years and resulted in an average score in 1996 that was higher than the average score in 1978. Although overall improvement was also indicated by the average scores of 13-year-old students attending nonpublic schools, there was no significant difference between the 1996 and 1978 average scores. Despite some fluctuations, there were no significant changes in the average scores of 17-year-olds attending nonpublic schools.

Chapter 4

Students' Experiences in Mathematics

With professional mathematics groups as well as federal legislation setting national goals for school mathematics, the focus on school mathematics in the United States has perhaps never been greater. Recommendations for reform include curriculum revision, more active learning and problem solving by students, encouragement of all students to reach their full potential through course selection and completion, and increased use of technology (calculators and computers) in the learning of mathematics.[26] Central to these new goals for school mathematics is the increased focus on student mastery of processes: problem solving, reasoning, communication, and connecting mathematical ideas across contexts. Calls for such a focus have come both from the mathematics community and from those who seek to employ the graduates of the nations' schools.[27]

This chapter examines relationships between average mathematics scores and self-reported student experiences in mathematics class such as classroom activities, course taking, and attitudes about mathematics. Results from the 1996 trend assessment are compared with results from the first assessment in which information on that experience was collected.

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[26] National Council of Teachers of Mathematics (1989). *Curriculum and evaluation standards for school mathematics.* Reston, VA.
National Council of Teachers of Mathematics (1991). *Professional standards for teaching school mathematics.* Reston, VA.

[27] Secretary's Commission on Achieving Necessary Skills (1992). *Learning a living: A blueprint for high performance.* Washington, DC: Department of Labor.
Committee on the Mathematical Education of Teachers (1991). *A call for change: Recommendations for the mathematical preparation of teachers of mathematics.* Washington, DC: Mathematical Association of America.

Mathematics Course Taking at Ages 13 and 17

Central to moving students to an internationally competitive level in mathematics is making sure that they have had an equal opportunity to learn the same mathematics content as their competitors. Studies across the time span of the NAEP trend assessment have indicated that U.S. students have not had such opportunities as a whole.[28] Others claim that even where U.S. schools provide equal opportunity for mathematics exposure, neither the focus of instruction nor the expectations for student performance match up with those found in the schoolrooms of our economic competitors.[29]

The NCTM teaching standards emphasize the need to extend both the amount of content that students learn and the number of courses that students take, as well as to change the way learning and teaching occur in school settings. This section examines the extent to which students are taking more advanced courses in the curriculum.

Table 4.1 presents trends in the types of mathematics classes taken by 13-year-olds over the last 10 years. Specific comparisons of 1996 and 1986 show that the percentage of students taking the regular mathematics curriculum has decreased, and the percentage taking pre-algebra classes has increased over that time period. Although the percentage has increased somewhat over the years, there was no significant difference between the proportion of students taking algebra in 1996 and in 1986. As would be expected, 13-year-olds pursuing higher levels of mathematics coursework in 1996 attained higher average mathematics scale scores. That is, 13-year-olds taking algebra had higher average scores than those taking pre-algebra, and students in pre-algebra outperformed their peers taking regular mathematics.

Table 4.1 **Mathematics Course Taking at Age 13, 1986 and 1996**

THE NATION'S REPORT CARD naep

	ALGEBRA		PREALGEBRA		REGULAR MATH		OTHER	
Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
1996	20 (1.0)	295 (1.4)	36 (2.0) *	277 (1.0)	39 (2.3) *	263 (1.2)	5 (0.6)	275 (5.2)
1986	16 (2.0)	299 (1.6)	19 (1.8)	280 (1.2)	61 (3.0)	261 (0.9)	5 (0.5)	262 (3.8)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1986.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[28] McKnight, C. C., Crosswhite, F. J., Dossey, J. A., Kifer, E., Swafford, J. O., Travers, K. J., & Cooney, T. J. (1987). *The underachieving curriculum.* Champaign, IL: Stipes.

Westbury, I., Ethington, C. A., Sosniak, L. A., & Baker, D. P. (Eds.). (1994). *In search of more effective mathematics education.* Norwood, NJ: Ablex Publishing.

[29] Stevenson, H. W. & Stigler, J. W. (1992). *The learning gap. Why our students are failing and what we can learn from Japanese and Chinese education* (New York, NY: Summit Books, 1992).

Peak, L. (1996). *Pursuing excellence: A study of U.S. eighth-grade mathematics and science teaching, learning, curriculum, and achievement in international context. Initial findings from the Third International Mathematics and Science Study.* Office of Educational Research and Improvement. Washington, DC: U.S. Government Printing Office.

Mathematics course taking is compulsory for 13-year-olds but not always for 17-year-old students. Table 4.2 presents trends in the mathematics course-taking profile of 17-year-old students for the nation and by gender. The results in the table represent the students' highest level mathematics course taken to date. Since most 17-year-olds are in eleventh or twelfth grade, one would expect that, if they were enrolled in a typical curriculum with no interruptions in their pursuit of mathematics courses, they would be enrolled in algebra II or higher. Results for the nation show that in 1996, about 63 percent of the students met this expectation. Greater percentages of students in 1996 than in 1978 had taken advanced algebra and calculus courses, while lower percentages reported that their highest level course was first-year algebra or less. The percentage of 17-year-olds for which geometry was the highest course taken has remained relatively stable across the assessments. On the whole, these changes indicate that more students are electing or being required to take higher level courses than their counterparts in 1978. These results are similar to those from other studies documenting a trend toward more advanced course work among high school seniors.[30]

Table 4.2

Highest Level of Mathematics Course Taken at Age 17, for the Nation and by Gender, 1978 and 1996

THE NATION'S REPORT CARD naep

		TOTAL		MALE		FEMALE	
	Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
Prealgebra or General Mathematics	1996	8 (0.6) *	269 (1.9)	9 (0.8) *	272 (2.5)	7 (0.8) *	265 (2.2)
	1978	20 (1.0)	267 (0.8)	21 (1.0)	269 (1.0)	20 (1.1)	265 (0.9)
Algebra I	1996	12 (1.0) *	283 (1.3)	14 (1.1)	287 (1.5)	11 (1.5) *	278 (2.2)
	1978	17 (0.6)	286 (0.7)	15 (0.6)	289 (0.9)	18 (0.7)	284 (1.0)
Geometry	1996	16 (1.0)	298 (1.3) *	17 (1.4)	302 (1.7) *	15 (1.0)	294 (1.5) *
	1978	16 (0.6)	307 (0.7)	15 (0.5)	310 (1.0)	18 (0.8)	304 (0.8)
Algebra II	1996	50 (1.6) *	316 (1.3) *	47 (2.1) *	320 (1.7)	53 (1.7) *	313 (1.4)
	1978	37 (1.2)	321 (0.7)	38 (1.2)	325 (0.8)	37 (1.3)	318 (0.9)
Precalculus or Calculus	1996	13 (1.1) *	339 (1.7)	13 (1.1) *	342 (2.3)	13 (1.3) *	335 (2.2)
	1978	6 (0.4)	334 (1.4)	7 (0.5)	337 (2.0)	4 (0.4)	329 (1.8)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1978.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

30 Blank, R. K. & Gruebel, D. (1995). *State indicators of science and mathematics education 1995: State-by-state trends and new indications from the 1993-94 school year.* Washington, DC: Council of Chief State School Officers.

In general, average mathematics scale scores for students at various levels of course taking have either declined or remained the same since 1978. Average mathematics scores in 1996 for 17-year-olds at the level of pre-algebra or first-year algebra were not significantly different from those in 1978. Among 17-year-olds whose highest level mathematics course was geometry or second-year algebra, the 1996 average score was below that in 1978. No significant difference between average scores in 1978 and 1996 was observed for students taking calculus.

An examination of the results by gender group indicates that the trend toward more advanced course work among 17-year-olds is evident for males and females. There were sharp declines for both groups in the percentages of students whose highest level of mathematics study was pre-algebra. A decline was also evidenced in the percentage of females whose highest level was algebra I. Conversely, for both gender groups, there was an increase from 1978 to 1996 in the percentages of students reaching algebra II and calculus. For both gender groups, the percentages whose highest level of mathematics study was geometry did not change significantly across the time period. The average scores in 1996 for both males and females at the geometry level were below those in 1978.

In 1996, males and females were compared with respect to the percentages at each level of mathematics course taking and the average scores at each level. A greater percentage of females than males reported that algebra II was their highest level of mathematics. None of the other percentage differences was significant. At the algebra I, geometry, algebra II, and calculus levels of course taking, males had higher average mathematics scores than did females. This result is consistent with the overall gender difference in mathematics scale scores evident among 17-year-olds.

Table 4.3 presents results on the highest level of mathematics course taken by racial/ethnic subgroups. In general, the trend toward more advanced course taking is evident among all three groups, albeit to varying degrees. Results on course taking for White students are similar to results found for the nation as a whole. That is, increases between 1978 and 1996 were observed in the percentages of White students reaching algebra II and calculus, as well as decreases in those whose highest level course was algebra I or less. Among Black and Hispanic 17-year-olds, the percentage that reported pre-algebra as their most advanced level also decreased from 1978 to 1996. The percentages at the algebra I level in 1978 and in 1996, however, did not significantly differ. As was found for White students, greater percentages of Black and Hispanic students reached algebra II in 1996 than in 1978. For Black students, there was also an increase in the percentage of students with geometry as their highest level of mathematics. Unlike White students, however, the proportion of Black and Hispanic students reaching calculus did not change significantly between 1978 and 1996.

Despite some increases in advanced course work, Black and Hispanic 17-year-olds were still less likely than their White peers in 1996 to be enrolled in the more challenging courses. Among 17-year-olds in 1996, a higher percentage of Hispanic than White students ended their mathematics course work at the pre-algebra level, and the percentage of students with algebra I as their highest level of mathematics was higher for Black than for White students. The percentage of White students whose highest course was algebra II was higher than that for Hispanic students, and a greater percentage of White than Black students had taken calculus.

In 1996, the percentages of Black 17-year-olds at the pre-algebra and calculus levels, and the percentage of Hispanic 17-year-olds at all levels except algebra II, were insufficient to statistically establish scale scores. However, where sample sizes were sufficient to make comparisons, White students outperformed their Black and Hispanic peers.

Combined, the results in Tables 4.1, 4.2, and 4.3 reflect a general upward movement in course taking as students face more challenging work, from the regular mathematics courses for 13-year-olds through the pre-calculus or calculus levels for 17-year-olds. These results for the nation at age 17 are generally consistent for gender groups and to varying degrees for specific racial/ethnic subgroups.

Table 4.3 Highest Level of Mathematics Course Taken at Age 17, by Race/Ethnicity, 1978 and 1996

THE NATION'S REPORT CARD NAEP

		WHITE		BLACK		HISPANIC	
	Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
Prealgebra or General Mathematics	1996	7 (0.7) *	273 (2.3)	9 (1.5) *	*** (***)	14 (2.5) *	*** (***)
	1978	18 (1.1)	272 (0.6)	31 (1.3)	247 (1.6)	36 (3.1)	256 (2.3)
Algebra I	1996	11 (1.2) *	287 (2.0)	18 (2.0)	273 (2.4)	16 (2.2)	*** (***)
	1978	17 (0.6)	291 (0.6)	19 (1.2)	264 (1.5)	19 (2.1)	273 (2.8)
Geometry	1996	15 (1.2)	304 (1.6) *	16 (1.4) *	280 (3.0)	19 (2.3)	*** (***)
	1978	17 (0.7)	310 (0.6)	11 (0.8)	281 (1.9)	12 (1.2)	294 (4.4)
Algebra II	1996	53 (1.6) *	320 (1.4)	45 (3.6) *	299 (2.2)	41 (3.6) *	306 (2.8)
	1978	39 (1.3)	325 (0.6)	28 (2.1)	292 (1.4)	23 (2.5)	303 (2.9)
Precalculus or Calculus	1996	13 (1.4) *	342 (1.9)	8 (1.3)	*** (***)	9 (2.3)	*** (***)
	1978	6 (0.4)	338 (1.1)	4 (0.6)	297 (6.5)	3 (0.9)	*** (***)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1978.

*** Sample size insufficient to permit a reliable estimate.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Classroom Instruction at Age 17

The NAEP trend assessment results provide an opportunity to study changes in curricular and instructional programs that affect the nation's 17-year-olds. Trend data have been collected since 1978 on students' classroom activities that may be related to learning mathematics. Some activities reflect active engagement in mathematics learning, such as participating in class discussions, completing reports or carrying out projects, and using the board to work on problems. Other activities are more passive, such as listening to the teacher explain a lesson and watching the teacher work problems on the board. Table 4.4 presents data on the frequency of these classroom activities and average scale scores for 1978 and 1996.

Table 4.4 Mathematics Classroom Activities at Age 17, 1978 and 1996

In your high school mathematics courses, how often did you. . .	Year	OFTEN		SOMETIMES		NEVER	
		Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
Listen to a teacher explain a mathematics lesson?	1996	86(0.6) *	310(1.5) *	11(0.8) *	301(3.5)	3(0.4)	287(5.5)
	1978	79(1.2)	304(1.5)	19(1.1)	294(3.2)	2(0.4)	***(***)
Discuss mathematics in class?	1996	62(1.8) *	311(1.6)	29(1.7) *	305(1.9) *	9(0.8)	298(2.9)
	1978	51(1.5)	306(1.8)	43(1.4)	298(1.8)	7(0.6)	289(4.0)
Watch the teacher work mathematics problems on the board?	1996	87(0.7) *	310(1.5) *	11(0.7) *	300(3.6)	3(0.4)	***(***)
	1978	80(1.1)	304(1.5)	18(0.9)	292(2.9)	2(0.4)	282(5.2)
Work mathematics problems on the board?	1996	27(1.4)	308(2.4)	49(1.5) *	311(1.6) *	24(1.1) *	302(1.7)
	1978	28(1.3)	303(1.9)	60(1.2)	302(1.8)	12(1.1)	293(3.9)
Make reports or do projects on mathematics?	1996	5(0.6) *	299(3.3)	35(1.4) *	312(1.6) *	60(1.6) *	307(1.8)
	1978	2(0.2)	***(***)	23(1.2)	300(2.5)	75(1.3)	302(1.5)
Take mathematics tests?	1996	84(1.0) *	310(1.6)	15(0.9) *	302(2.9) *	2(0.3)	***(***)
	1978	64(1.3)	308(1.7)	33(1.1)	292(2.1)	3(0.5)	270(4.7)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1978.

*** Sample size insufficient to permit a reliable estimate.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

In 1996, 86 percent of 17-year-olds reported that they “Often” listened to the teacher explain a mathematics lesson, and 87 percent “Often” watch the teacher work problems on the board. Both of these responses represent increases over those in 1978. A corresponding decrease from 1978 to 1996 was evidenced in the percentages of students who responded “Sometimes” to these items. These results indicate an increase in passive student activities since 1978. Such shifts in classroom activity are not consistent with the recommendations of the NCTM teaching standards.

On the other hand, student responses about “Often” discussing mathematics in class showed an increase from 1978 to 1996, paralleling a decrease in the “Sometimes” responses. The increase in classroom discussion indicates a movement toward meeting the present recommendations for teaching mathematics. Students in 1996 were also more likely than those in 1978 to report that they “Often” or “Sometimes” prepared reports or did projects on mathematics (and less likely to report that they “Never” did so). These results provide further evidence of a change in practice that corresponds to the suggested teaching approaches for getting students involved in creating or doing mathematics. In contrast to these changes, a higher percentage of students in 1996 than in 1978 reported that they “Never” worked mathematics problems on the board.

Seventeen-year-olds were also asked how often they take mathematics tests in class. About 84 percent of the students responded that they “Often” take mathematics tests, reflecting a considerable increase since 1978. A decrease was also observed for the “Sometimes” category. Whether this shift is toward or against the recommendations for change depends on the types of tests associated with the increased frequency. If the tests were different forms of assessment, providing teachers with information to improve instruction or learning, then the movement would be a positive one. If the tests focused on short-term goals and on procedures, however, the movement would be contrary to current recommendations.

Use of Technology in Mathematics Classes at Ages 13 and 17

As part of the information collected on the learning context and students' opportunity to learn, 13- and 17-year-olds were asked questions about the availability and use of computers in mathematics instruction. As shown in Table 4.5, over half of the nation's 13-year-olds in 1996 had studied mathematics through computer instruction and had access to computers for learning mathematics. Nearly three-fourths of 13-year-olds reported that they used computers when solving mathematics problems. These percentages reflect substantial increases over the percentages reported in 1978. Among 17-year-olds, over half reported having access to computers to learn mathematics in 1996. About 42 percent had studied mathematics through computer instruction, and 70 percent had used a computer in solving mathematics problems. Consistent with the results for 13-year-olds, the percentages of 17-year-olds responding "Yes" to these items in 1996 were higher than those observed in 1978.

Students at age 17 were also asked whether they had taken a course in computer programming. The percentage of students who responded affirmatively to this item rose from 1978 (10 percent) to 1996 (26 percent).

Table 4.5 **Availability and Use of Computers at Ages 13 and 17, 1978 and 1996**

THE NATION'S REPORT CARD naep

		Percentage of students reporting "Yes"	
		Age 13	Age 17
Had access to computer to learn mathematics	1996	56 (1.8) *	57 (2.3) *
	1978	12 (1.8)	24 (2.7)
Studied mathematics through computer instruction	1996	54 (1.8) *	42 (2.1) *
	1978	14 (0.9)	12 (1.1)
Used a computer to solve mathematics problems	1996	74 (1.2) *	70 (2.2) *
	1978	56 (1.4)	46 (1.5)
Took a course in computer programming	1996	Question not asked at age 13.	26 (1.2) *
	1978		10 (0.9)

Standard errors of the estimated percentages appear in parentheses.

* Indicates that the percentage in 1996 is significantly different than that in 1978.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Attitudes Toward Mathematics at Ages 13 and 17

Students' attitudes toward mathematics, their ability to use it, and its usefulness in their world are key goals stated for the K-12 curriculum in the NCTM teaching standards. Students' beliefs about the nature of mathematics may be key to their decisions to pursue mathematics, participate in classroom activities designed to provide opportunities to learn, and persist in applying mathematics to solve problems. To explore their views about mathematics, students were given statements and were asked to indicate their degree of agreement or disagreement with each. Table 4.6 contains a summary of 13- and 17-year-old students' responses to these statements.

The first four statements dealt with students' experience with mathematics itself including general liking for and self-perceptions of ability in mathematics. Almost two-thirds of 13- and 17-year-olds in 1996 were either undecided or did not want to take more mathematics courses. For 13-year-olds, this represented an increase since 1978. In contrast, about 72 percent of 13- and 17-year-olds in 1996 reported that they were undecided or disagreed that they were taking mathematics only because they had to. These percentages were not significantly different from those reported in 1978.

For both 13- and 17-year-olds, the percentages of students who agreed that they are good in mathematics increased between 1978 and 1996, indicating more favorable perceptions of ability. No significant difference between the years was observed in the percentage of 17-year-olds who agreed with the statement, "I usually understand what we are talking about in mathematics."

The last two statements dealt with students' perceptions of mathematics as a discipline. The statement, "Mathematics helps a person think logically," was agreed to by nearly three-fourths of 13- and 17-year-olds, indicating a fairly consistent view across adolescents that mathematics provides a rational base for thinking through problems and situations. No significant change was observed between 1978 and 1996 in these percentages for either age group. The statement, "New discoveries are seldom made in mathematics," sampled students' views about the dynamic nature of the subject. About one-third of 17-year-olds agreed with this statement in 1996. This percentage was higher than in 1978, indicating that fewer students affirmed the dynamic nature of mathematics. Among 13-year-olds, about one-third also agreed with this statement in 1996, although this percentage was not significantly different from that in 1978.

Table 4.6

Attitudes Towards Mathematics at Ages 13 and 17, 1978 and 1996

	Age	Year	STRONGLY AGREE OR AGREE: Percent of Students	STRONGLY AGREE OR AGREE: Average Scale Score	UNDECIDED, DISAGREE, OR STRONGLY DISAGREE: Percent of Students	UNDECIDED, DISAGREE, OR STRONGLY DISAGREE: Average Scale Score
I would like to take more mathematics.	13	1996	39 (1.3) *	276 (2.3) *	61 (1.3) *	275 (1.6) *
		1978	50 (1.5)	263 (2.6)	51 (1.5)	268 (1.4)
	17	1996	37 (1.3)	309 (1.8)	63 (1.3)	305 (1.7) *
		1978	39 (1.7)	304 (2.0)	61 (1.7)	295 (1.7)
I am taking mathematics because I have to.	13	1996	28 (1.1)	270 (2.1) *	72 (1.1)	278 (1.7) *
		1978	29 (1.4)	256 (2.4)	71 (1.4)	270 (1.9)
	17	1996	28 (1.4)	300 (2.3) *	72 (1.4)	309 (1.1) *
		1978	27 (1.5)	287 (2.5)	73 (1.5)	302 (1.8)
I am good at mathematics.	13	1996	71 (1.6) *	279 (1.7) *	29 (1.6) *	267 (2.4) *
		1978	65 (1.3)	270 (2.0)	35 (1.3)	258 (1.9)
	17	1996	60 (1.3) *	312 (1.4)	40 (1.3) *	298 (2.1) *
		1978	54 (1.5)	307 (2.0)	46 (1.5)	289 (1.5)
I usually understand what we are talking about in mathematics.	13	1996	Question not asked at age 13.			
		1978				
	17	1996	71 (1.3)	308 (1.5)	29 (1.3)	302 (2.4) *
		1978	67 (1.1)	303 (1.8)	33 (1.1)	290 (2.1)
Mathematics helps a person think logically.	13	1996	71 (1.1)	277 (1.9) *	29 (1.1)	271 (2.1) *
		1978	74 (1.1)	268 (1.9)	26 (1.1)	261 (2.4)
	17	1996	74 (1.1)	308 (1.3) *	26 (1.1)	302 (2.8) *
		1978	77 (1.1)	301 (1.7)	23 (1.1)	289 (2.2)
New discoveries are seldom made in mathematics.	13	1996	34 (1.4)	273 (1.8) *	66 (1.4)	277 (1.9)
		1978	36 (1.5)	255 (2.2)	64 (1.5)	272 (1.5)
	17	1996	32 (1.4) *	301 (2.2) *	68 (1.4) *	309 (1.5) *
		1978	19 (1.2)	284 (3.2)	81 (1.2)	302 (1.5)

Standard errors of the estimated percentages and scale scores appear in parentheses.
* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1978.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Television Watching at Ages 9, 13, and 17

Table 4.7 presents students' reports about the amount of time they spend watching television per day. For 9- and 13-year-olds, 1982 was the first year this question was asked. For 17-year-olds, the first year was 1978. Students were asked to select the number of hours they watched television, and the data were aggregated into three categories: 0-2 hours, 3-5 hours, and 6 or more hours. Since 1986, NAEP has also tracked students' responses to a question about whether their family has any rules about watching television, and these data are shown in Table 4.8.

Table 4.7 **Television Watching at Ages 9 and 13, 1982 and 1996; and at Age 17, 1978 and 1996**

		Number of Hours Watched Per Day					
		0-2 Hours		3-5 Hours		6 or More Hours	
	Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
AGE 9	1996	47(1.1)	233(1.2) *	36(1.0) *	234(1.0) *	18(0.9) *	220(1.4) *
	1982	44(1.1)	218(1.4)	29(0.6)	227(1.1)	26(1.0)	215(1.2)
AGE 13	1996	39(1.2) *	281(1.4) *	48(0.9) *	273(0.9) *	13(0.6) *	258(1.5)
	1982	45(0.8)	273(1.2)	39(0.4)	269(1.1)	16(0.8)	256(1.8)
AGE 17	1996	54(1.2) *	314(1.2) *	39(1.1) *	302(1.5) *	7(0.5) *	285(2.8)
	1978	69(0.7)	305(1.0)	26(0.6)	296(1.1)	5(0.2)	279(2.1)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1978 or 1982.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Among 9-year-olds, students reported somewhat less television watching than their 1982 counterparts. The percentage of students who reported watching television 6 or more hours a day decreased between 1982 and 1996, and a greater proportion indicated that they watched 3 to 5 hours. There was no significant change from 1982 to 1996 in the percentage of students who reported watching 0 to 2 hours each day. Among 13-year-olds, there was a decrease in the percentage of students who reported 6 or more hours of television viewing per day, and an increase in the percentage who reported watching 3 to 5 hours a day. In addition, a smaller proportion of 13-year-olds in 1996 reported watching little or no television each day (0 to 2 hours) compared to their counterparts in 1982.

An increase in television viewing is evidenced among 17-year-olds. Between 1978 and 1996, a smaller percentage reported watching only 0 to 2 hours of television per day, and a larger percentage reported watching 3 or more hours.

Specific comparisons were made to study the relationship between amount of television watching and average mathematics scale scores in 1996. At ages 13 and 17, students who watched more hours of television had significantly lower mathematics scores than students who watched fewer or no hours. At age 9, students who reported watching 6 or more hours of television per day had lower average mathematics scores than their peers who reported less television watching. There was no significant difference between the average scores of 9-year-olds who reported watching 0 to 2 hours and those who reported watching 3 to 5 hours.

Students' degree of television watching might be influenced by whether there are parental rules for this. Among 9-year-olds, a greater percentage of students reported that their parent(s) had rules about television watching in 1996 than in 1986. In contrast, no significant change was observed among 13- or 17-year-olds over this time period. In 1996, 44 percent of 9-year-olds and 27 percent of 13-year-olds reported having family rules about television watching. Only 12 percent of age 17 students reported having these rules. In 1996, there was no significant relationship between students' reports about television rules and their average mathematics scale scores.

Table 4.8

Students' Reports About Family Rules for Television Watching, Ages 9, 13, and 17, 1986 and 1996

		YES		NO	
	Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
AGE 9	1996	44 (1.1) *	232 (1.2) *	56 (1.1) *	230 (0.9) *
	1986	37 (0.7)	220 (1.0)	63 (0.7)	223 (1.2)
AGE 13	1996	27 (1.0)	275 (1.3) *	73 (1.0)	274 (0.9) *
	1986	27 (1.2)	270 (1.6)	74 (1.2)	269 (1.1)
AGE 17	1996	12 (0.6)	307 (2.2) *	88 (0.6)	307 (1.2) *
	1986	11 (0.6)	300 (2.4)	89 (0.6)	303 (0.8)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1986.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Mathematics Homework at Age 17

One aspect of current interest in mathematics reform is the amount of homework assigned. Age 17 students were asked how often, in general, they do mathematics homework. As shown in Table 4.9, 75 percent of students reported doing mathematics homework "Often" in 1996; this represented an increase since 1978. The percentage who reported doing homework "Sometimes" decreased from 35 percent to 20 percent during this time period. The proportion of students who reported "Never" doing mathematics homework was small (5 to 6 percent) and did not significantly change since 1978.

For each of the three homework groups, average mathematics scores in 1996 were not significantly different from those in 1978. Comparisons of average scores in 1996 showed that students who did the greatest amount of mathematics homework tended to have higher mathematics scores. In 1996, students who reported doing mathematics homework "Often" had higher average mathematics scale scores than their peers who reported spending less time on homework. In interpreting these results, it should be considered that students' reports on the frequency of doing homework is not an indication of the content, quality, or difficulty of the assigned homework.

Table 4.9 **Frequency of Doing Mathematics Homework at Age 17, 1978 and 1996**

THE NATION'S REPORT CARD naep

		OFTEN		SOMETIMES		NEVER	
	Year	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
AGE 17	1996	75 (1.7) *	312 (1.6)	20 (1.3) *	299 (2.3)	5 (0.9)	293 (4.3)
	1978	59 (2.0)	309 (1.6)	35 (1.9)	291 (2.1)	6 (0.7)	284 (3.5)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1978.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Summary

- Between 1986 and 1996, the percentage of 13-year-olds taking the regular mathematics curriculum decreased and the percentage taking pre-algebra increased, but there was no significant difference in the percentages taking algebra. In 1996, higher mathematics scores were observed for 13-year-old students taking more advanced mathematics course work.
- In 1996, 63 percent of 17-year-olds had enrolled in algebra II or a higher level of course work in mathematics. In general, 17-year-olds were taking more advanced coursework in 1996 than in 1978. That is, greater percentages of students were taking algebra II and calculus as their highest courses, while smaller percentages reported that their highest level of mathematics study was algebra I or less.
- Between 1978 and 1996, no significant differences were observed in average mathematics scores among 17-year-olds who had taken course work no higher than pre-algebra or algebra. Age 17 students who had taken course work no higher than geometry and algebra II had a 1996 average score that was below that in 1978. Among 17-year-olds who had taken calculus, there was no significant difference between 1978 and 1996 in average scores.
- For both male and female 17-year-olds, greater percentages of students in 1996 than in 1978 reported that their highest level of mathematics course work was algebra II or calculus. Likewise, the percentage of males and females ending their mathematics studies at the pre-algebra or general mathematics level decreased during this time period, as did the percentage of females ending their studies with first-year algebra. The 1996 average score was below that in 1978 for both males and females whose highest course was geometry.
- The only difference between male and female course taking in 1996 was a greater percentage of females with algebra II as their highest level of mathematics coursework. In 1996, male 17-year-olds had higher average mathematics scores than females among those students who reported algebra I, geometry, algebra II, or calculus as their highest levels of coursework.
- Between 1978 and 1996, the percentage of 17-year-old White students who had taken algebra II or calculus as their highest course increased, and a decrease was observed in the percentage of students ending their mathematics studies with algebra I or less. During this same time period, the percentages of Black and Hispanic 17-year-olds ending their mathematics studies at the pre-algebra level decreased, and the percentages of these students who had taken algebra II as their highest course increased. Increases were also observed in the percentage of Black students taking geometry as their highest mathematics course work.
- In 1996, the percentage of White 17-year-olds whose highest course work was algebra II was higher than that for Hispanic students, and a greater percentage of White than Black students reached the calculus level. Compared to White students, a higher percentage of Hispanic and Black students ended their mathematics coursework with pre-algebra and algebra I, respectively. Although sample sizes were insufficient to make most comparisons, White students had higher average scores than Black students among those who reported algebra I and geometry as their highest course work. Also, White students outperformed both Black and Hispanic among those who reported that their highest course work was algebra II.

- Compared to 1978, higher percentages of 17-year-olds in 1996 reported discussing mathematics in class and doing reports and projects in mathematics. In contrast, greater percentages of 17-year-olds in 1996 than in 1978 reported passive participation in the classroom in the form of listening to the teacher explain lessons and watching the teacher work problems on the board. Also, a greater percentage of students reported never working mathematics problems on the board in 1996 than in 1978. About 84 percent of 17-year-olds reported that they often take mathematics tests, which was an increase over the percentage reported in 1978.
- Greater percentages of 13- and 17-year-olds reported having studied mathematics through computer instruction, used computers when solving mathematics problems, and had access to computers for learning mathematics in 1996 than in 1978. In 1996, a greater percentage of 17-year-olds took a course in computer programming than in 1978.
- The majority of 13- and 17-year-olds in 1996 were either undecided or did not want to take more mathematics courses. For 13-year-olds, this represented an increase over the percentage in 1978. For both 13- and 17-year-olds, greater percentages of students agreed that they were good in mathematics in 1996 than in 1978. About one-third of both 13- and 17-year-olds agreed with a statement reflecting the belief that mathematics is a static field; for 17-year-olds, this reflected an increase over the percentage reported in 1978.
- The percentages of 9- and 13-year-olds who reported watching 6 or more hours of television per day decreased between 1982 and 1996. For both groups, increases were observed during this time period in the percentages who watched 3 to 5 hours. Also, a smaller proportion of 13-year-olds reported watching 0 to 2 hours of television in 1996 than in 1982. Among 17-year-olds between 1978 and 1996, a smaller percentage reported watching 0 to 2 hours of television per day, and the percentage watching 3 or more hours a day increased. Among 9-year-olds, the percentage of students whose parents held rules about television watching increased between 1986 and 1996; no significant differences were observed for 13- or 17-year-olds over this time period.
- A greater percentage of 17-year-olds in 1996 than in 1978 reported that they often did mathematics homework and a smaller percentage reported doing mathematics homework sometimes. The percentage of students who reported never doing homework did not significantly change during this time period. Seventeen-year-olds who did homework more often had higher average mathematics scores than students who did homework less frequently or never.

Part III Reading

Introduction

During the last 25 years, many advances in reading theory have led to new developments in the teaching of reading. Increased emphasis on comprehension and use of a more diverse range of reading materials are among many examples of how reading instruction has changed during the last quarter of a century. More recently, reading education has received increased attention from policy makers and educational organizations. In 1996, standards for the teaching of language arts, including reading, were released by two prominent professional organizations: the International Reading Association and the National Council of Teachers of English.[1] In addition, two federal initiatives set forth in 1997 — The America Reads Challenge, a program to recruit and train a million reading tutors to work with elementary school children, and a proposed national test to measure individual fourth graders' reading achievement — highlight the nation's commitment to students' reading achievement.

In the context of these recent efforts to increase student achievement in reading, the NAEP long-term trend assessment in reading provides one measure of the progress that has been made during the last 25 years and, perhaps, establishes a basis for expectations of future progress. To monitor progress across time in the reading achievement of American students, NAEP has conducted nine national assessments of reading performance involving representative samples of 9-, 13-, and 17-year-old students. These assessments were conducted in the 1970-71, 1974-75, 1979-80, 1983-84, 1987-88, 1989-90, 1991-92, 1993-94, and 1995-96 school years. They will subsequently be referred to by the latter half of the school year in which they occurred: 1971, 1975, 1980, 1984, 1988, 1990, 1992, 1994, and 1996.

Over the past few decades, theoretical discussions and pedagogical approaches have evolved within the field of reading in response to a growing awareness of the complexities of reading comprehension. Reading teachers and parents are becoming increasingly concerned with students' development of higher-order cognitive processes and strategies that facilitate in-depth and critical understanding of reading materials. In addition, research has indicated that reading is not simply a unitary skill but rather is characterized by interactive and constructive processes that vary according to contexts and purposes for reading. Accordingly, many educators and researchers have called for a reading curriculum that includes a wide variety of text types and reading activities.

[1] National Council of Teachers of English and International Reading Association (1996). *Standards for the English language arts.* Urbana, IL and Newark, DE.

Beyond the research and reform efforts in reading instruction, the development of lifelong literacy habits and abilities that are fostered through family and environmental support are of growing concern. More and more, educators and parents agree that students must not only develop the ability to comprehend what they read but also develop an orientation to literacy that leads to lifelong reading and learning. Meeting such goals has been the impetus behind recent efforts to establish stronger links between schools and homes, and to involve parents more directly in helping students to meet these educational goals.

These current issues provide a dynamic context for examining and interpreting the results of NAEP's reading trend assessments. Part III of this report is intended to serve as a resource for groups concerned with improving students' reading achievement — not only reading teachers and researchers, but also educators in other subjects, policy makers, school administrators, and parents. Together with information from other sources, the findings provide a basis for discussing the adequacy of students' current reading achievement, in light of factors that appear to be related to reading abilities. These discussions may then lead to further development of means for improving reading performance in the years ahead.

The NAEP Long-Term Trend Reading Assessment

The NAEP reading trend assessment incorporates a wide range of text materials, from simple narrative passages to complex articles on specialized topics.[2] The selections include stories, poems, essays, reports, and passages from textbooks of varying levels of difficulty, as well as sample train schedules, telephone bills, and advertisements. Students' comprehension is assessed with a variety of question types. Some multiple-choice questions require students to identify particular information presented in the text. Constructed-response questions require students to restructure and interpret what they have read and to present their responses in writing. In order to measure trends over time, the same sets of reading materials and questions are administered in each assessment.

Students participating in each assessment were asked to provide information on their demographic characteristics, instructional experiences, and reading behaviors. The relationships observed between reading performance and self-reported background information can help educators, reading researchers, and policy makers to identify and discuss central issues and concerns and can guide further inquiries.

In addition to the NAEP 1996 long-term trend reading assessment which has measured trends since 1971, a separate "main" NAEP reading assessment was conducted in 1992 and 1994 and is planned for re-administration in 1998. The main NAEP reading assessment is based on a more recent framework representing current thinking about reading development and assessment. Its content consists entirely of authentic reading materials which are longer than those in the long-term trend assessment and which represent materials typically available to students in and out of school. Also, the newer assessment includes a greater proportion of constructed-response questions, and it measures students' achievement in reading for three purposes: reading for literary experience, reading to gain information, and reading to perform

[2] *Reading objectives, 1983-84.* Princeton, NJ: Educational Testing Service.

a task. Students participating in the newly developed reading assessments (1992 and 1994) were selected by grade definitions (4, 8, and 12) and completed the assessment at a different time of year than did students participating in the long-term trend assessment. The 1994 results from the newer assessment were published in an earlier report, *NAEP 1994 Reading Report Card for the Nation and the States.*[3] Because of the many differences between the two reading assessments, the results are not directly comparable.

Analysis Procedures

NAEP uses analysis techniques based on item response theory (IRT) to estimate students' reading ability on a scale ranging from 0 to 500. The NAEP reading scale is useful in making comparisons across assessments for the three age groups and among subpopulations of students. (The Procedural Appendix contains more detailed information about analysis procedures and student subgroups.) To provide a basis for interpreting the results, this report describes what students attaining different performance levels on the scale are able to do. Based on the assessment results, five levels of reading performance were defined:

Level 150 – Simple, Discrete Reading Tasks;

Level 200 – Partially Developed Skills and Understanding;

Level 250 – Interrelate Ideas and Make Generalizations;

Level 300 – Understand Complicated Information; and

Level 350 – Learn from Specialized Reading Materials.

Essentially, students performing at Level 150 were able to carry out simple, discrete reading tasks. At Level 200, students demonstrated partial skills and basic understanding of what they read. Performance at Level 250 suggests the ability to search for specific information, interrelate ideas, and make generalizations. Students performing at Level 300 were able to find, understand, summarize, and explain relatively complicated information. Those performing at Level 350 showed some ability to synthesize and learn from specialized reading materials.

NAEP reports the performance of groups and subgroups of students, not individuals. The measures of achievement included in this report are the average performance of groups of students on the NAEP reading scale and the percentages of students attaining successive levels of performance on the scale. Because the average scale scores and percentages presented in this report are based on samples, they are necessarily estimates. Like all estimates based on surveys, they are subject to sampling as well as measurement error. To compute standard errors, NAEP uses a complex procedure that estimates the sampling error and other random error associated with observed assessment results.

The 1996 assessment was statistically compared to two previous assessments: the prior assessment in 1994, and the first assessment which provided sufficient data on the variables being tested (i.e., the base year). The purpose of year-to-year statistical tests was to determine whether the results in the 1996 assessment were different from the results of the previous

[3] Campbell, J. R., Donahue, P. L., Reese, C. M., & Phillips, G. W. (1996). *NAEP 1994 reading report card for the nation and the states.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

assessment or whether any changes had taken place since the base year assessment. Tests of other year-to-year comparisons can be found in previous reports of NAEP long-term trend assessments.

In addition to comparisons between individual assessment years, a second test of significance was conducted to detect statistically significant linear and quadratic trends across assessments. (See the Procedural Appendix for a discussion of the procedure.) This type of analysis makes it possible to discuss statistically significant patterns that may be missed by year-to-year comparisons. For example, from assessment to assessment, students' average scale scores may consistently increase (or decrease) by a small amount. Although these small increases (or decreases) between years may not be statistically significant under pairwise multiple comparisons, the overall increasing (or decreasing) trend in average scores may be statistically significant and noteworthy. The purpose of trend tests is to determine whether the results of the series of assessments could be generally characterized by a line or a simple curve. A linear trend tests for cumulative change over the entire assessment period, such as an increase or decrease at a relatively constant rate. Simple curvilinear (i.e., quadratic) relationships represent more complex patterns. Two examples of such patterns include initial score declines over part of the time period followed by subsequent increases in more recent assessments, or a pattern of initial score increases over a time period followed by a period of relatively stable performance.

This Section

Each chapter in this section of the report provides a somewhat different perspective on trends in students' reading abilities. Chapter 5 describes changes in the average reading performance of 9-, 13-, and 17-year-olds across the nine reading trend assessments conducted by NAEP since 1971. Chapter 6 summarizes trends in students' responses to questions about their reading instruction and experiences, and investigates the relationships between these background factors and reading achievement.

In Chapter 5, the results of statistical tests conducted to determine significant differences between 1996 and the first assessment year, and between 1996 and 1994, are indicated in grids that appear next to or below the figures and tables. The results from tests comparing the base year and 1996 assessments are summarized in the column labeled with the asterisk symbol "*." Significant differences are denoted with a "+" or "-" sign indicating that the 1996 average score was either greater than or less than the base year score, respectively. Similarly, significant differences between 1994 and 1996 assessment results are denoted with a "+" or "-" sign under the column labeled with the dagger symbol "‡" indicating that the 1996 average score was either greater or smaller than the 1994 average, respectively. The results from the linear and quadratic trend tests are summarized in the columns labeled "L" and "Q," respectively. Within each column, significant positive trends are denoted by a "+" sign and significant negative trends are denoted with a "-" sign. In Chapter 6, where only the first and most recent assessment results are presented, significant differences between the base year and 1996 are indicated within the tables. All of the differences and trend patterns discussed in this report are statistically significant at the .05 level.

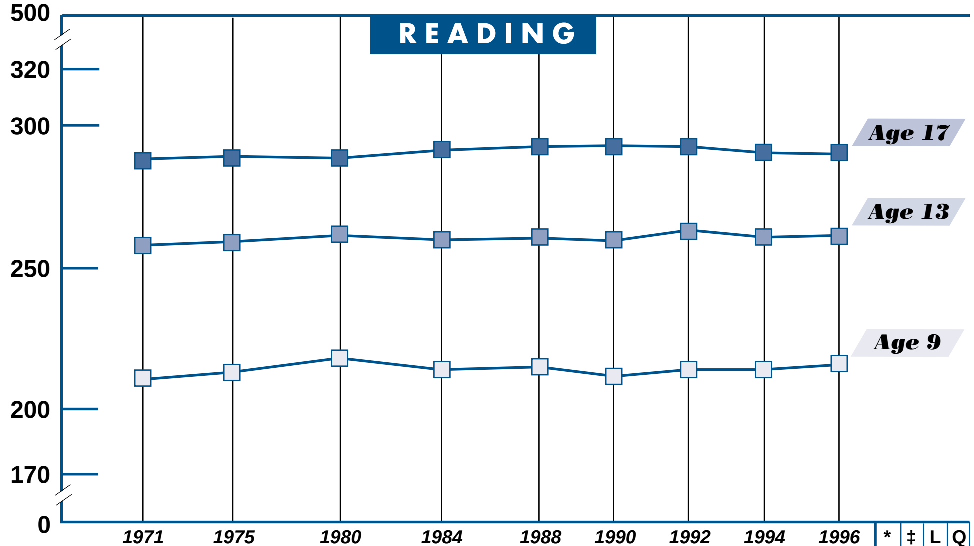
Chapter 5

Reading Scores for the Nation and Selected Subpopulations

Results for the Nation from 1971 to 1996

The results of the nine trend assessments in reading conducted from 1971 to 1996 are presented in Figure 5.1. This figure provides an indication of the trends in students' reading achievement over the past 25 years.

Figure 5.1 **Trends in Average Reading Scale Scores for the Nation, 1971 to 1996**



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	285(1.2)	286(0.8)	286(1.2)	289(0.6)	290(1.0)	290(1.1)	290(1.1)	288(1.3)	288(1.1)			+	–
Age 13	255(0.9)	256(0.8)	259(0.9)	257(0.5)	258(1.0)	257(0.8)	260(1.2)	258(0.9)	258(1.0)	+		+	
Age 9	208(1.0)	210(0.7)	215(1.0)	211(0.7)	212(1.1)	209(1.2)	211(0.9)	211(1.2)	213(1.0)	+			–

Standard errors of the estimated scale scores appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1971.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Seventeen-year-olds. Among 17-year-olds, a pattern of increases in performance was observed in assessments during the 1970s and 1980s. However, this pattern has not continued in recent assessments. Although the overall trend is one of moderate gains, the average score of students in 1996 did not differ significantly from that of their counterparts in 1971 or in 1994.

Thirteen-year-olds. Across the assessment years, 13-year-olds demonstrated an overall pattern of marginally increased performance. Although there was no significant change since 1994, the 1996 average score remained higher than the 1971 average.

Nine-year-olds. Although increases in the average scores of 9-year-olds were observed in the assessments from 1971 to 1980, scores did not continue to increase after that time. Little change has been observed during the last decade; however, the average score of 9-year-olds in 1996 was higher than that in 1971, but not significantly different from that in 1994.

National Trends in Levels of Reading Performance from 1971 to 1996

To provide more specific information about the types of reading abilities displayed by students, five levels of performance have been identified and described along the NAEP scale: 150, 200, 250, 300, and 350.[4] An empirical procedure, used to "anchor" performance at the five levels on the scale, delineated sets of questions likely to be answered successfully by students who performed at a particular level and much less likely to be answered successfully by students performing at the next lower level. The selected questions were then analyzed by reading experts in order to develop a detailed picture of the reading skills displayed by students at each of the five levels. The descriptions in Figure 5.2 characterize the reading abilities of most students at each of the five levels.

4 In theory, performance levels above 350 and below 150 could have been defined; however, so few students in the assessment performed at the extreme ends of the scale that it was not practical to do so.

Figure 5.2 Levels of Reading Performance

THE NATION'S REPORT CARD naep

Level 350:

Learn from Specialized Reading Materials

Readers at this level can extend and restructure the ideas presented in specialized and complex texts. Examples include scientific materials, literary essays, and historical documents. Readers are also able to understand the links between ideas, even when those links are not explicitly stated, and to make appropriate generalizations. Performance at this level suggests the ability to synthesize and learn from specialized reading materials.

Level 300:

Understand Complicated Information

Readers at this level can understand complicated literary and informational passages, including material about topics they study at school. They can also analyze and integrate less familiar material about topics they study at school as well as provide reactions to and explanations of the text as a whole. Performance at this level suggests the ability to find, understand, summarize, and explain relatively complicated information.

Level 250:

Interrelate Ideas and Make Generalizations

Readers at this level use intermediate skills and strategies to search for, locate, and organize the information they find in relatively lengthy passages and can recognize paraphrases of what they have read. They can also make inferences and reach generalizations about main ideas and author's purpose from passages dealing with literature, science, and social studies. Performance at this level suggests the ability to search for specific information, interrelate ideas, and make generalizations.

Level 200:

Partially Developed Skills and Understanding

Readers at this level can locate and identify facts from simple informational paragraphs, stories, and news articles. In addition, they can combine ideas and make inferences based on short, uncomplicated passages. Performance at this level suggests the ability to understand specific or sequentially related information.

Level 150:

Simple, Discrete Reading Tasks

Readers at this level can follow brief written directions. They can also select words, phrases, or sentences to describe a simple picture and can interpret simple written clues to identify a common object. Performance at this level suggests the ability to carry out simple, discrete reading tasks.

Table 5.1 presents the percentages of students who performed at or above each reading performance level in the nine reading assessments conducted by NAEP since 1971. It is expected that older students will have more success with the increasingly difficult reading tasks reflected in the higher performance level descriptions. This was the case, as students showed a clear pattern of increased reading abilities from ages 9 to 17.[5] (Data on performance levels by gender, race/ethnicity, modal grade, region, parents education level, type of school, and quartiles can be found in the Data Appendix.)

Table 5.1 — **Trends in Percentage of Students At or Above Five Reading Performance Levels, 1971 to 1996**

THE NATION'S REPORT CARD naep

Performance Levels	Age	Assessment Years 1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Level 350 Learn from Specialized Reading Materials	9	0(***)	0(***)	0(***)	0(***)	0(***)	0(***)	0(***)	0(***)	0(***)				
	13	0(0.0)	0(0.0)	0(0.0)	0(0.1)	0(0.1)	0(0.1)	1(0.3)	1(0.1)	1(0.2)	+		+	
	17	7(0.4)	6(0.3)	5(0.4)	6(0.3)	5(0.6)	7(0.5)	7(0.6)	7(0.7)	7(0.8)				+
Level 300 Understand Complicated Information	9	1(0.1)	1(0.1)	1(0.1)	1(0.1)	1(0.3)	2(0.3)	1(0.2)	1(0.3)	1(0.2)				
	13	10(0.5)	10(0.5)	11(0.5)	11(0.4)	11(0.8)	11(0.6)	15(0.9)	14(0.8)	14(1.0)	+		+	
	17	39(1.0)	39(0.8)	38(1.1)	40(0.8)	41(1.5)	41(1.0)	43(1.1)	41(1.2)	39(1.4)			+	
Level 250 Interrelate Ideas and Make Generalizations	9	16(0.6)	15(0.6)	18(0.8)	17(0.6)	18(1.1)	18(1.0)	16(0.8)	17(1.2)	17(0.8)				–
	13	58(1.1)	59(1.0)	61(1.1)	59(0.6)	59(1.3)	59(1.0)	62(1.4)	60(1.2)	60(1.3)				
	17	79(0.9)	80(0.7)	81(0.9)	83(0.5)	86(0.8)	84(1.0)	83(0.8)	81(1.0)	82(0.8)	+		+	–
Level 200 Partially Developed Skills and Understanding	9	59(1.0)	62(0.8)	68(1.0)	62(0.7)	63(1.3)	59(1.3)	62(1.1)	63(1.4)	64(1.3)	+			
	13	93(0.5)	93(0.4)	95(0.4)	94(0.3)	95(0.6)	94(0.6)	93(0.7)	92(0.6)	92(0.7)				–
	17	96(0.3)	96(0.3)	97(0.3)	98(0.1)	99(0.3)	98(0.3)	97(0.4)	97(0.5)	98(0.5)	+		+	–
Level 150 Simple, Discrete Reading Tasks	9	91(0.5)	93(0.4)	95(0.4)	92(0.3)	93(0.7)	90(0.9)	92(0.4)	92(0.7)	94(0.6)	+			
	13	100(0.0)	100(0.1)	100(0.1)	100(0.0)	100(0.1)	100(0.1)	100(0.3)	99(0.2)	100(0.2)			–	–
	17	100(0.1)	100(0.1)	100(0.1)	100(0.0)	100(***)	100(***)	100(0.1)	100(0.1)	100(***)				

Standard errors of the estimated percentages appear in parentheses. When no standard error appears (***), standard error estimates may not be accurately determined and/or the sampling distribution of the statistic does not match statistical test assumptions. In these cases statistical tests have not been conducted. (See Procedural Appendix.)

* Indicates that the percentage in 1996 is significantly larger (+) or smaller (–) than that in 1971.

‡ Indicates that the percentage in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[5] The performance levels are based upon a vertical scale that assumes reading ability is cumulative. Younger students are not expected to perform at the same level as older students. Therefore, most 9-year-olds are not expected to reach the upper levels of performance.

In theory, performance levels above 350 and below 150 could have been defined; however, so few students in the assessment performed at the extreme ends of the reading scale that it was not practical to do so.

Level 350. The percentage of students demonstrating the more advanced reading abilities outlined at Level 350, such as learning from specialized reading materials, continued to be quite small in 1996. For 17-year-olds, a decline in the percentage of students at this level during the 1970s has reversed, so that in 1996 the percentage was not significantly different from that in 1971.

Level 300. The percentage of 13-year-olds performing at or above Level 300 (understanding of complicated information) increased across the assessments and was higher in 1996 than in 1971. The overall pattern for 17-year-olds at this level was also one of moderately increased performance. However, in 1996 the percentage who performed at or above Level 300 was not significantly different from that in 1971.

Level 250. Interrelating ideas and making generalizations were characteristic of performance at Level 250. Although some decline since 1988 has been observed among 17-year-olds, the 1996 percentage was higher than that in 1971. For 9-year-olds, the percentage of students at or above Level 250 fluctuated across the assessment years and declined somewhat since 1990.

Level 200. In 1996, as in past assessments, nearly all of the 17-year-old students and the overwhelming majority of 13-year-old students performed at or above Level 200, demonstrating at least partially developed skills and understanding. At age 13, there was some indication that earlier gains in the percentages of students at this level have not continued since 1988. Although slightly less than two-thirds (64 percent) of 9-year-olds performed at or above Level 200, this was higher than in 1971.

Level 150. Across the assessment years, nearly all 13- and 17-year-old students and the overwhelming majority of 9-year-olds were successful with the simple, discrete reading tasks representative of this level. Among 9-year-olds, the 1996 percentage of students at or above Level 150 was higher than that in 1971.

Trends in Reading Scale Scores by Quartile from 1971 to 1996

Figure 5.3 presents average reading scale scores for 9-, 13-, and 17-year-old students who were in the upper quartile (upper 25 percent), the middle two quartiles (middle 50 percent), and the lower quartile (lower 25 percent) of student performance in each assessment. These data reveal changes that have occurred in the last 25 years for students at different points along the performance distribution. An examination of these data can provide a picture of how students with lower or higher reading abilities have progressed across the assessment years. This information is particularly relevant in light of the objective of Goal 3 of The National Education Goals, which states that "the academic performance of elementary and secondary students will increase significantly in every quartile...."[6] The goal emphasizes that students of all abilities should be granted access to educational opportunities and should demonstrate gains in educational achievement. The long-term trend results presented in Figure 5.3 display varied patterns of change for students across the performance distribution at all three grades.

Seventeen-year-olds. For 17-year-old students in the upper quartile, the decrease that was observed between 1975 and 1980 has reversed, and the pattern over the entire period between 1971 and 1996 is one of slightly increasing performance. The average score of these students in 1996, however, did not differ significantly from that of their counterparts in 1971. Among students in the middle two quartiles, the overall pattern was one of increased performance until the most recent assessments. In 1996, the average score did not differ significantly from that in 1971. In the lower quartile, a pattern of growth was observed during the 1970s and 1980s. Although scores have declined since their highs in the late 1980s, the overall trend was positive, and the average in 1996 remained higher than the average in 1971.

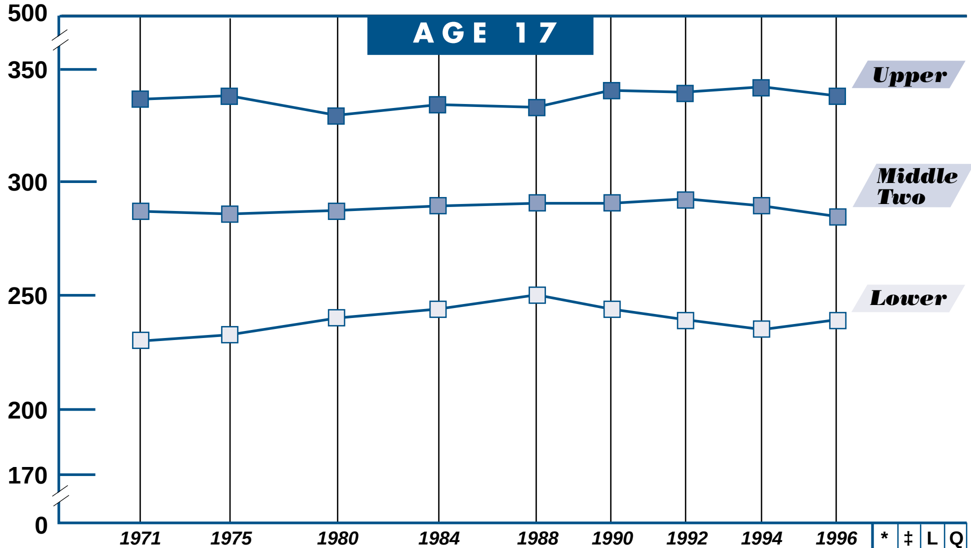
Thirteen-year-olds. At age 13, early and more recent gains among students in the upper quartile have resulted in an overall pattern of increased performance and an average score in 1996 that was higher than that in 1971. At the middle two quartiles, an overall trend of increased performance has also been observed, and the 1996 average score was higher than the 1971 average score. For students in the lower quartile, gains that were observed in 1980 have not been maintained, so that the average in 1996 was not significantly different from that in 1971.

Nine-year-olds. Among 9-year-olds, students in the upper quartile demonstrated an overall pattern of increased performance since 1971. Although scores declined slightly after 1990, the average score of these students in 1996 remained higher than that of their counterparts in 1971. In the middle two quartiles, early gains that were observed from 1971 to 1980 have not been maintained. Nonetheless, in 1996 the average scores of the middle and lower performing students were higher than those observed in 1971.

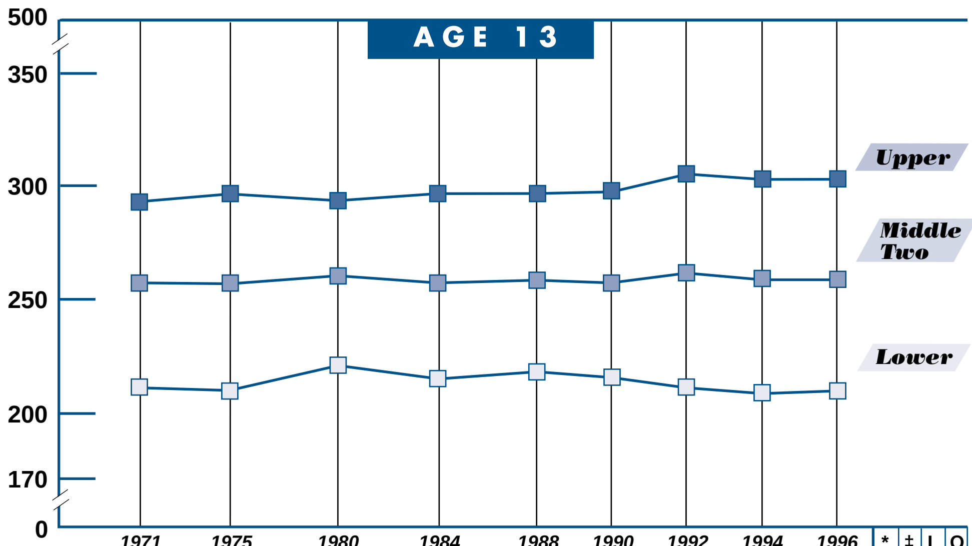
[6] National Education Goals Panel (1996). *The national education goals reports: Building a nation of learners.* Washington, DC: U.S. Government Printing Office.

Figure 5.3

Trends in Average Reading Scale Scores by Quartile, 1971 to 1996



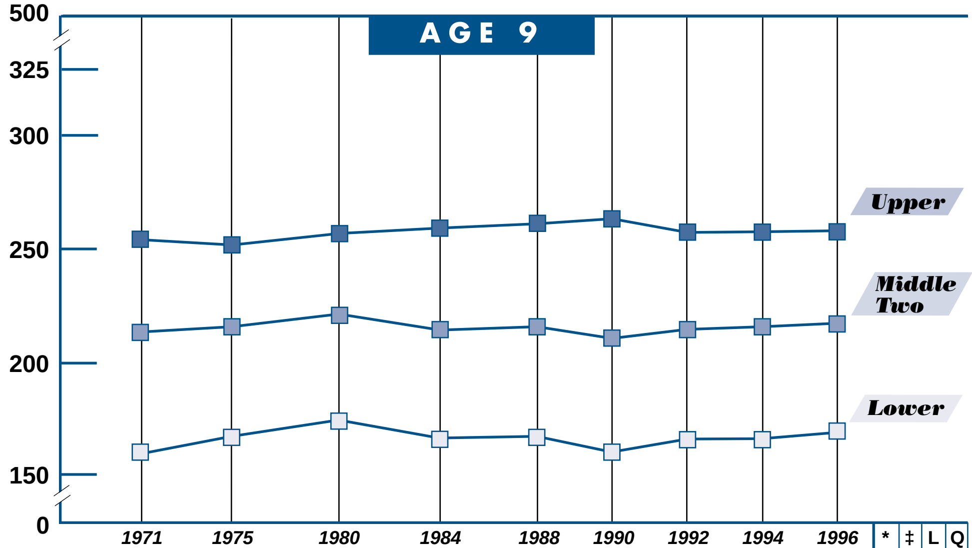
	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	333(0.6)	334(0.5)	327(0.8)	331(0.5)	330(1.3)	336(1.1)	335(0.9)	337(1.3)	334(1.2)			+	+
Middle Two	289(0.5)	288(0.4)	289(0.4)	291(0.3)	292(0.7)	292(0.5)	293(0.7)	291(0.7)	289(1.0)			+	–
Lower Quartile	230(0.8)	232(1.0)	238(1.0)	241(0.3)	246(1.1)	241(1.6)	237(1.3)	234(1.3)	238(1.1)	+		+	–



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	293(0.4)	296(0.4)	294(0.5)	296(0.5)	296(1.0)	297(0.8)	303(1.1)	301(0.8)	301(1.2)	+		+	+
Middle Two	258(0.4)	258(0.4)	261(0.3)	258(0.2)	259(0.7)	258(0.5)	262(0.6)	260(0.8)	260(0.7)	+		+	
Lower Quartile	212(0.7)	211(0.5)	219(0.7)	215(0.5)	217(1.0)	215(0.9)	212(1.4)	210(0.9)	211(1.4)				–

Figure 5.3 (continued)

Trends in Average Reading Scale Scores by Quartile, 1971 to 1996



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Upper Quartile	253(0.5)	251(0.7)	255(0.8)	258(0.4)	259(1.6)	261(1.1)	256(0.9)	256(1.0)	256(0.8)	+		+	–
Middle Two	211(0.4)	213(0.3)	218(0.3)	212(0.3)	213(0.7)	209(0.6)	212(0.7)	213(0.7)	214(0.7)	+			–
Lower Quartile	157(0.7)	163(0.5)	169(1.0)	162(0.6)	163(1.6)	157(1.5)	162(1.0)	162(1.4)	166(1.7)	+			

Standard errors of the estimated scale scores appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1971.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Reading Scale Scores by Race/Ethnicity from 1971 to 1996

Figure 5.4 shows trends in average reading scale scores for White, Black, and Hispanic students.[7] For White and Black students, results are reported from the first trend reading assessment in 1971. For Hispanic students, results are reported from 1975, the first year in which the sample allowed an accurate estimate of the scores for this population.

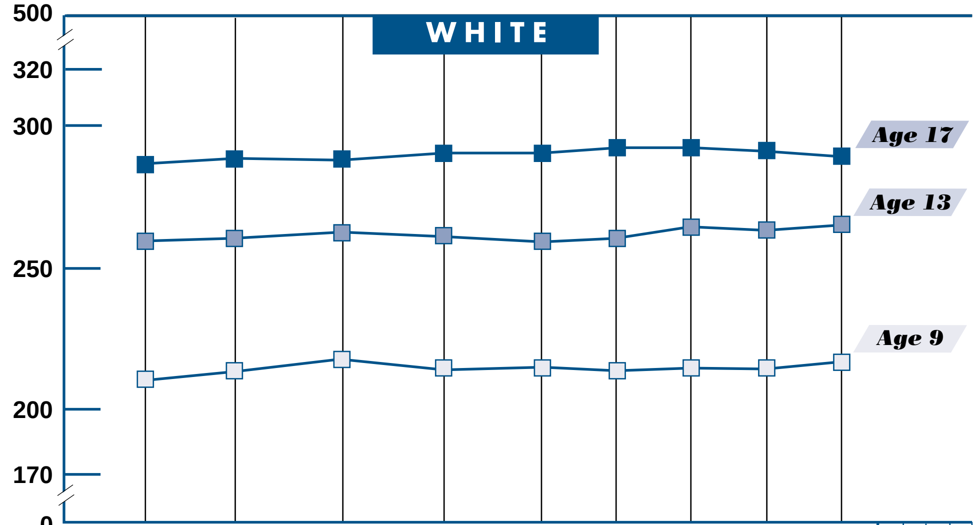
White Students. Although an overall pattern of improving performance was observed for 17-year-old White students, the average score for these students in 1996 was not significantly different from that of their counterparts in 1971. For both 9- and 13-year-old White students, the overall trend in reading scores was one of increased performance across the assessment years. In both age groups, the 1996 average score was higher than the 1971 average.

Black Students. In all age groups, Black students demonstrated a pattern of performance gains through the 1970s and 1980s followed by a period of decline in the early 1990s. However, the overall trend was positive, and the 1996 average score in each group remained higher than the 1971 average.

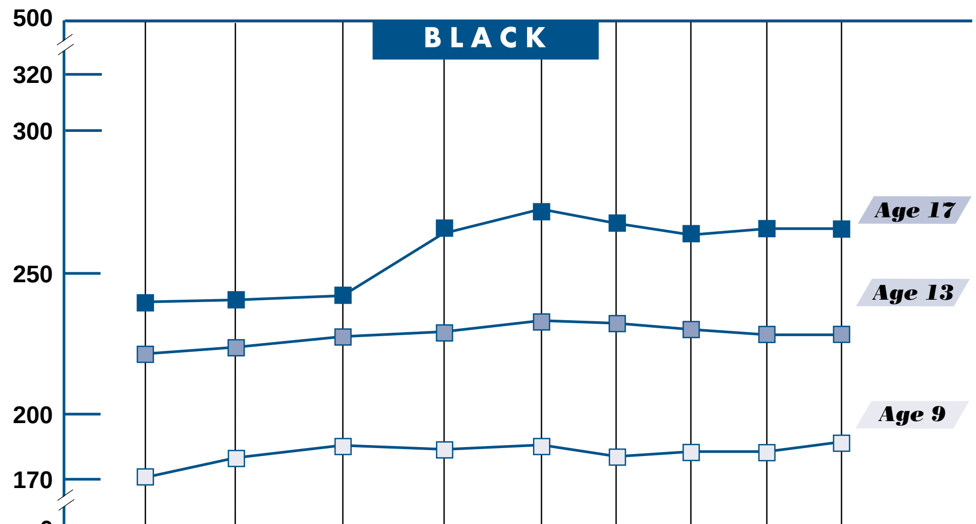
Hispanic Students. Among 17-year-old Hispanic students, the overall pattern was one of increased performance, but declining scores during the 1990s have resulted in a 1996 average that did not differ significantly from that of their counterparts in 1975. At age 13, the average scores of Hispanic students shown no pattern of increases or decreases, so that performance in 1996 did not differ significantly from that in 1975. The average scores of 9-year-old Hispanic students have fluctuated somewhat across the assessment years, but the 1996 average score was higher than the 1975 average.

[7] For Asian/Pacific Islander students and American Indian students, the sample sizes were insufficient to permit reliable trend estimates.

Figure 5.4 Trends in Average Reading Scale Scores by Race/Ethnicity, 1971 to 1996



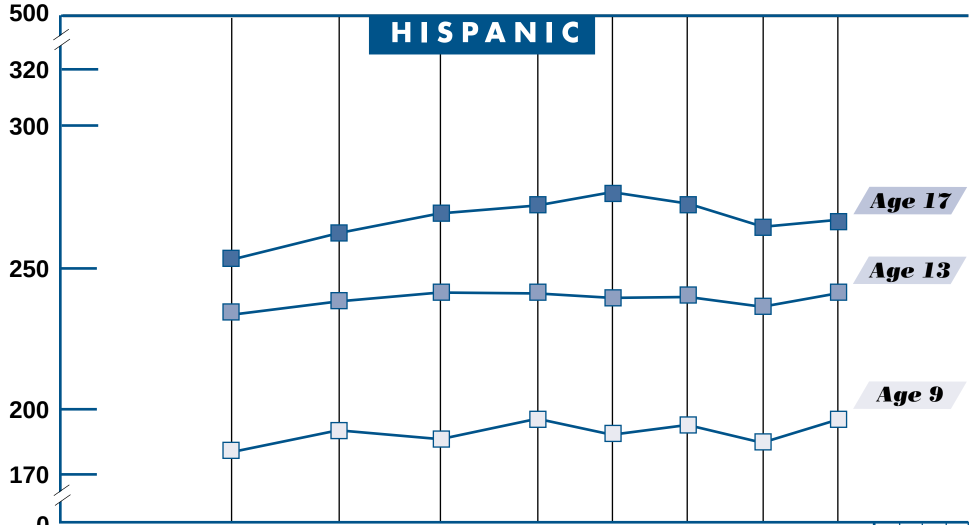
	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	291(1.0) 87(1.3)	293(0.6) 84(1.0)	293(0.9) 83(1.6)	295(0.7) 77(0.6)	295(1.2) 77(0.6)	297(1.2) 74(0.5)	297(1.4) 75(0.6)	296(1.5) 72(0.8)	295(1.2) 72(0.7)			+	
Age 13	261(0.7) 84(1.4)	262(0.7) 81(1.2)	264(0.7) 80(1.8)	263(0.6) 77(0.6)	261(1.1) 76(0.7)	262(0.9) 74(0.8)	266(1.2) 73(0.7)	265(1.1) 74(0.5)	266(1.0) 71(0.7)	+		+	
Age 9	214(0.9) 84(1.4)	217(0.7) 80(1.2)	221(0.8) 79(1.3)	218(0.8) 75(1.2)	218(1.4) 75(1.0)	217(1.3) 74(1.0)	218(1.0) 74(0.9)	218(1.3) 75(0.7)	220(1.2) 71(0.9)	+		+	



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	239(1.7) 11(1.2)	241(2.0) 11(0.8)	243(1.8) 12(1.4)	264(1.0) 14(0.2)	274(2.4) 15(0.3)	267(2.3) 16(0.3)	261(2.1) 15(0.3)	266(3.9) 15(0.3)	266(2.7) 15(0.3)	+		+	–
Age 13	222(1.2) 15(1.4)	226(1.2) 13(0.9)	233(1.5) 14(1.3)	236(1.0) 14(0.2)	243(2.4) 15(0.3)	242(2.2) 15(0.2)	238(2.3) 16(0.4)	234(2.4) 15(0.5)	234(2.6) 15(0.6)	+		+	–
Age 9	170(1.7) 14(1.3)	181(1.2) 13(0.8)	189(1.8) 14(1.0)	186(1.1) 16(0.5)	189(2.4) 16(0.7)	182(2.9) 16(0.6)	185(2.2) 16(0.4)	185(2.3) 15(0.6)	191(2.6) 17(0.5)	+		+	–

Figure 5.4 (continued)

Trends in Average Reading Scale Scores by Race/Ethnicity, 1971 to 1996



	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	252(3.6) 3(0.6)	261(2.7) 4(0.6)	268(2.2) 7(0.7)	271(4.3) 6(0.5)	275(3.6) 7(0.4)	271(3.7) 8(0.6)	263(4.9) 8(0.5)	265(4.1) 9(0.6)			+	–
Age 13	233(3.0) 5(0.8)	237(2.0) 6(1.0)	240(1.7) 7(0.7)	240(3.5) 6(0.6)	238(2.3) 8(0.5)	239(3.5) 7(0.4)	235(1.9) 8(0.4)	238(2.9) 9(0.6)				
Age 9	183(2.2) 5(0.8)	190(2.3) 6(0.8)	187(2.1) 7(1.4)	194(3.5) 6(1.0)	189(2.3) 6(0.6)	192(3.1) 7(0.8)	186(3.9) 6(0.4)	195(3.4) 8(1.0)	+			

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1971 (for White and Black students) or in 1975 (for Hispanic students).

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Reading Scale Scores by Gender from 1971 to 1996

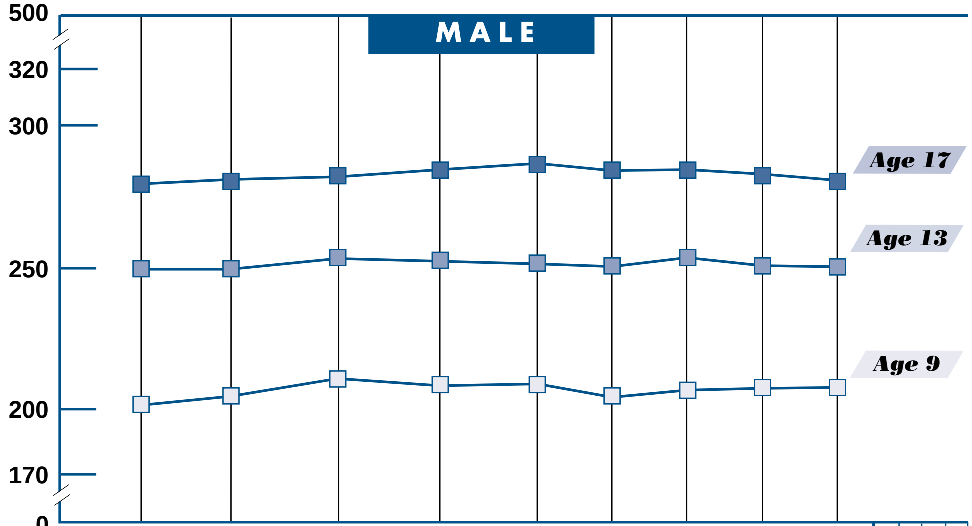
Figure 5.5 presents trends in average reading scale scores for male and female students at all three ages.

Male Students. Among 17-year-old male students, increases were observed throughout the 1970s and 1980s; however, during the 1990s, scores declined. Although no significant difference was observed between the 1996 and 1971 average scores, the overall pattern was one of improved performance. At age 13, the average scores of male students have fluctuated somewhat across the assessment years; gains that were observed in 1980 have not been maintained. The performance of 9-year-old male students increased until 1980. Although these gains did not continue, the overall pattern was one of improved performance and the 1996 average score for 9-years-olds remained higher than that of their 1971 counterparts.

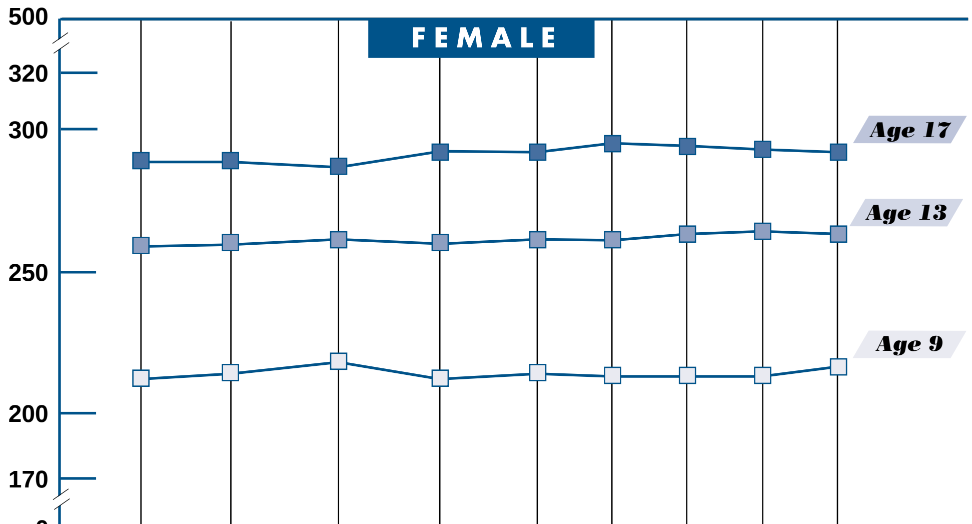
Female Students. At age 17, the overall pattern for female students was one of improved performance; however, their average score in 1996 did not differ significantly from that of their counterparts in 1971. For 13-year-old female students, average scores improved overall across the assessment years, so that performance in 1996 was higher than that in 1971. Although no overall trend pattern was observed for 9-year-old female students across the assessment years, the average score attained by these students in 1996 was higher than that of their counterparts in 1971.

Figure 5.5

Trends in Average Reading Scale Scores by Gender, 1971 to 1996



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	279(1.2) 49(0.5)	280(1.0) 49(0.5)	282(1.3) 51(0.6)	284(0.6) 51(0.7)	286(1.5) 48(1.3)	284(1.6) 50(0.6)	284(1.6) 52(0.9)	282(2.2) 50(1.4)	281(1.3) 51(1.0)			+	–
Age 13	250(1.0) 50(0.4)	250(0.8) 50(0.5)	254(1.1) 49(0.3)	253(0.6) 51(0.5)	252(1.3) 50(0.8)	251(1.1) 50(0.9)	254(1.7) 49(0.9)	251(1.2) 51(0.8)	251(1.2) 49(0.9)				–
Age 9	201(1.1) 50(0.4)	204(0.8) 50(0.4)	210(1.1) 50(0.4)	208(0.8) 50(0.5)	208(1.4) 50(0.8)	204(1.7) 51(0.9)	206(1.3) 51(0.7)	207(1.3) 50(0.8)	207(1.4) 49(0.9)	+		+	–



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	291(1.3) 51(0.5)	291(1.0) 51(0.5)	289(1.2) 50(0.6)	294(0.8) 49(0.7)	294(1.5) 52(1.4)	297(1.2) 50(0.6)	296(1.1) 48(0.9)	295(1.5) 50(1.4)	295(1.2) 49(1.0)			+	
Age 13	261(0.9) 50(0.4)	262(0.9) 50(0.5)	263(0.9) 51(0.3)	262(0.6) 49(0.5)	263(1.0) 51(0.8)	263(1.1) 50(0.9)	265(1.2) 51(0.9)	266(1.2) 49(0.8)	264(1.2) 51(0.9)	+		+	
Age 9	214(1.0) 50(0.4)	216(0.8) 50(0.4)	220(1.1) 50(0.4)	214(0.8) 50(0.5)	216(1.3) 50(0.8)	215(1.2) 49(0.9)	215(0.9) 49(0.7)	215(1.4) 50(0.8)	218(1.1) 51(0.9)	+			

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1971.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Differences in Average Reading Scale Scores by Race/Ethnicity and by Gender

The previous two sections presented trends in reading achievement for White, Black, and Hispanic students, and for male and female students. As with past NAEP assessments, significant performance differences between racial/ethnic subgroups and between males and females were observed in 1996. Academic performance differences between White and minority students have been the focus of numerous research studies and policy initiatives. Some studies have identified differential opportunities for learning and supportive environments as factors contributing to discrepancies in educational achievement.[8] For example, research suggests that the learning opportunities of minority students may be diminished by substandard school and curricular resources, or by fewer economic and home resources.[9]

These factors are consistent with other research that has used NAEP results to explore differences in performance between racial groups.[10] Recent arguments demonstrate that reporting unadjusted differences among racial groups may be misleading since these groups come from different family, school, and community contexts that are related to achievement. When achievement results are controlled for social context, test score differences between groups may be reduced.[11] Other research shows that while a substantial performance gap still exists, the performance difference between non-Hispanic White 13- and 17-year-olds and their Hispanic and Black peers has narrowed between 1975 and 1990. Gains among Black and Hispanic students, however, could not be explained by changing family characteristics (parental education level, family size, family income) alone.[12]

Gender differences in reading and writing achievement have also been examined. Research often points to differences in social influences and educational expectations to explain, in part, the higher average reading and writing scores attained by female students.[13] Figure 5.6 presents trends in differences between the average scale scores for selected subgroups of students across the assessment years.

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8 Dulaney, C., & Bethune, G. (1995). *Racial and gender gaps in academic achievement: An updated look at 1993-94 data.* (Report Summary). Wake County Public Schools System, Raleigh, NC: Department of Evaluation and Research. (ERIC Document Reproduction Service No. ED 384 417)

Stevens, F. (1993). *Opportunity to learn: Issues of equity for poor and minority students.* Washington, DC: National Center for Education Statistics.

9 Fine, M. (1991) *Framing dropouts*. Albany, NY: State University of New York Press.

MacIver, D. J., & Epstein, J. L. (1990). *How equal are opportunities for learning in disadvantaged and advantaged middle grade schools?* (Report No. 7). Center for Research on Effective Schooling for Disadvantaged Students. Baltimore, MD: Johns Hopkins University.

10 Berends, M., & Koretz, D. M. (1995). Reporting minority students' test scores: How well can the National Assessment of Educational Progress account for differences in social context? *Educational Assessment, 3(3),* 249-285.

Jaynes, G. D., & Williams, R. M. Jr. (Eds.). (1989). *A common destiny: Blacks and American society.* Washington, DC: National Academy Press.

Grissmer, D. W., Kirby, S. N., Berends, M., & Williamson, S. (1994). *Student achievement and the changing American family.* Santa Monica, CA: Rand.

11 Berends, M., & Koretz, D. M. op. cit.

12 Grissmer, D. W., et. al., op. cit.

13 Cummings, R. (1994). 11th graders view differences in reading and math. *Journal of Reading, 38*(3), 196-199.

Schick, R. (1992). *Social and linguistic sources of gender differences in writing composition.* Paper presented at the Annual meeting of the National Reading Conference, San Antonio, TX.

White-Black and White-Hispanic. An examination of performance in 1996 among the three ethnic groups showed that, at all ages, White students outperformed their Black and Hispanic peers. The gap between the average scores of White and Black students aged 13 and 17 narrowed between 1971 and 1988, going from a 53-point difference to a 20-point difference at age 17, and from 39 points to 18 points at age 13. This trend was the result of average scores for Black students increasing 35 points for 17-year-olds and 21 points for 13-year-olds. In comparison, the average scores for White students increased no more than 4 points at either age. Since 1988, however, there is evidence that the trend toward smaller gaps among 13- and 17-year-olds has reversed due to decreasing scores for Black students. In 1996, the average scores of 13- and 17-year-old Black students were lower than those of their counterparts in 1988, by 9 points at age 13 and by 8 points at age 17. Among their White peers, however, 13-year-olds have shown an increase of 5 points and 17-year-olds have shown no change since 1988. Even with the recent widening of the gap, in 1996 the score difference between White and Black students at age 17 remained smaller than that in 1971. However, there was no significant difference between the 1996 and 1971 gaps for 13-year-olds. Among 9-year-olds, scale score gaps have generally decreased across the assessment years, resulting in a smaller gap in 1996 compared to that in 1971.

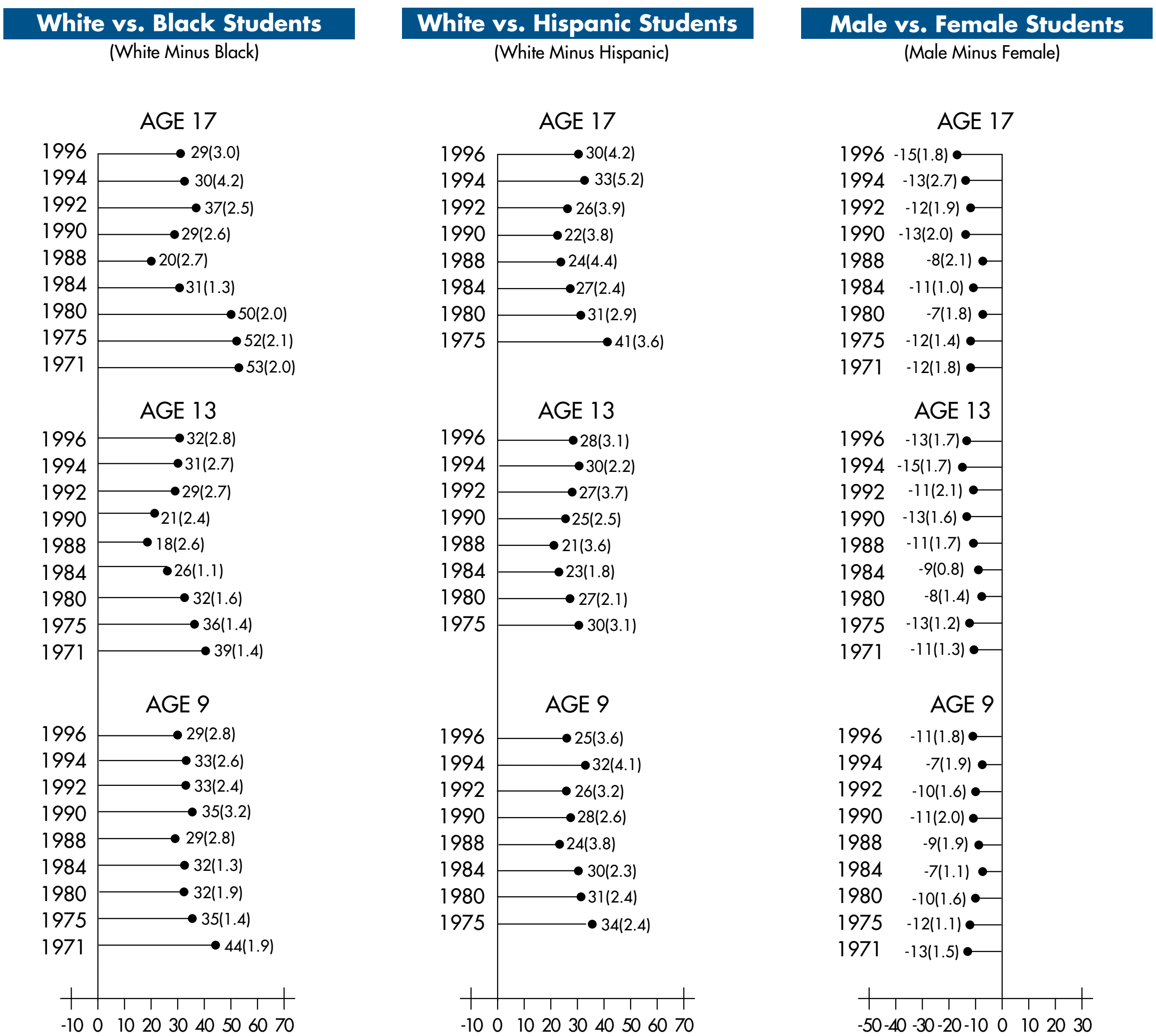
The gap between White and Hispanic students aged 9 and 13 was relatively consistent across the assessment years. At age 17, the magnitude of the gap decreased from 1975 to 1990 as the average score for Hispanic students increased 23 points, while the average for White students increased only 4 points. Due to a pattern of decreasing performance among Hispanic students since 1990, however, the gap between White and Hispanic 17-year-olds' average scores returned to a level in 1996 that did not differ significantly from that in 1975.

Male-Female. Consistent with other studies documenting differences in literacy development between males and females, the NAEP reading trend assessments revealed a continued disparity between the two groups, with female students outperforming male students.[14] Despite some fluctuations, the difference between the average scores of 9-year-old males and females has remained relatively consistent across the assessment years. At ages 13 and 17, there were indications that the gaps between males and females decreased slightly between 1971 and 1980, but have fluctuated or increased since that time, so that the gaps in 1996 were not significantly different from those in 1971.

[14] Campbell, J. R., Donahue, P. L., Reese, C. M., & Phillips, G. W. (1996). *NAEP 1994 reading report card for the nation and the states.* National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Plewis, I. (1992, Summer). Pupils' progress in reading and mathematics during primary school: Associations with ethnic group and sex. *Educational Leadership, 33,* 133-140.

Figure 5.6	Trends in Differences in Average Reading Scale Scores by Race/Ethnicity and Gender



White vs. Black Students

	*	‡	L	Q
Age 17	–		–	+
Age 13			–	+
Age 9	–		–	

White vs. Hispanic Students

	*	‡	L	Q
Age 17				+
Age 13				
Age 9				

Male vs. Female Students

	*	‡	L	Q
Age 17				–
Age 13				–
Age 9				

Standard errors of the estimated scale score differences appear in parentheses.

* Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1971 (for White vs. Black student and Male vs. Female student differences) or in 1975 (for White vs. Hispanic student differences).

‡ Indicates that the average scale score difference in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Reading Scale Scores by Region from 1971 to 1996

Figure 5.7 presents trends in average reading scale scores for students from the Northeast, Southeast, Central, and West regions of the country.

Northeast. For 13- and 17-year-old students, no overall trend was observed across the assessment years, and the 1996 average scores were not significantly different from the 1971 averages. For 13-year-olds, the 1996 average score was lower than the 1994 average. Although an overall trend pattern was not apparent across the assessment years for 9-year-olds in the Northeast, the 1996 average score for this age group was higher than the 1971 average.

Southeast. The average scores of 13- and 17-year-olds displayed a pattern of improvement from 1971 to 1988 followed by a period of declining scores. Although the overall pattern remains one of increased performance, in 1996 the average score for both age groups returned to a level that did not differ significantly from that in 1971. For 9-year-olds in the Southeast, some fluctuation was observed in average scores since 1971. However, the 1996 average for this age group was higher than the 1971 average.

Central. For students in each age group in the Central region, no consistent pattern of increasing or decreasing scores was observed across the assessment years. The 1996 average scores did not differ significantly from 1971.

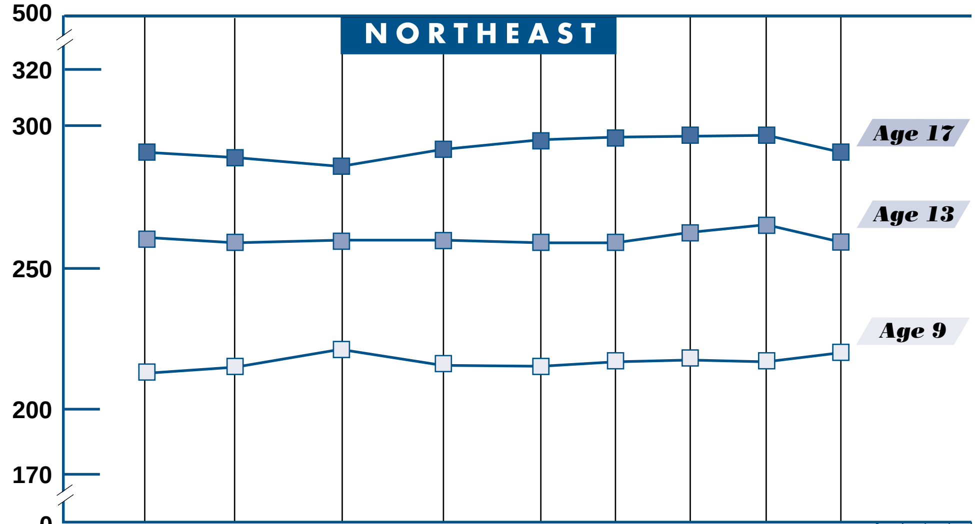
West. Despite slight fluctuations, the average scores of students in the West region have not changed significantly since the first assessment year. The 1996 average scores of students in each age group did not differ significantly from those observed in 1971.

In 1996, comparisons of average scale scores for each age group indicated several instances of significant differences between regions. At age 9, students in the Northeast outperformed their peers in the Southeast and West regions. Among 13-year-olds, students in the Central region had higher average scores in 1996 than did students in the Northeast, Southeast, and West regions. At age 17, students in the Northeast and the Central regions had higher average scores than students in the Southeast region.

Figure 5.7 Trends in Average Reading Scale Scores by Region, 1971 to 1996

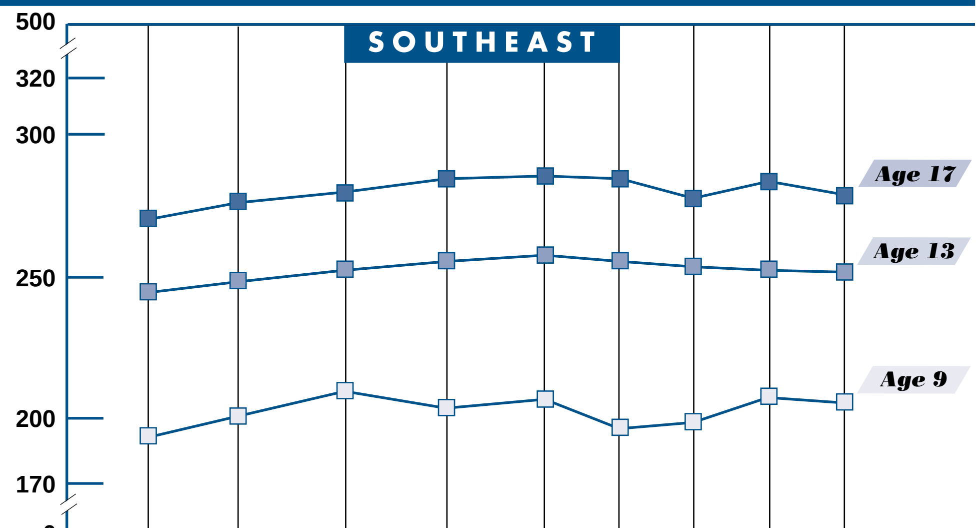
THE NATION'S REPORT CARD naep

NORTHEAST



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	291(2.8) 26(1.9)	289(1.7) 26(1.2)	286(2.4) 22(2.9)	292(1.9) 24(0.4)	295(2.9) 23(0.8)	296(1.8) 23(1.1)	297(3.2) 22(0.9)	297(4.2) 22(1.2)	292(2.8) 22(2.6)				
Age 13	261(2.0) 24(1.5)	259(1.8) 25(1.1)	260(1.8) 24(2.2)	260(0.6) 23(0.4)	259(2.4) 23(2.2)	259(1.8) 23(1.0)	265(3.2) 22(0.8)	269(2.0) 20(0.7)	259(2.6) 23(2.3)		–		
Age 9	213(1.7) 26(1.5)	215(1.3) 27(1.1)	221(2.1) 23(2.1)	216(1.7) 22(0.4)	215(2.6) 22(1.5)	217(2.2) 22(1.1)	218(2.6) 21(1.3)	217(2.9) 22(1.0)	220(1.8) 24(2.7)	+			

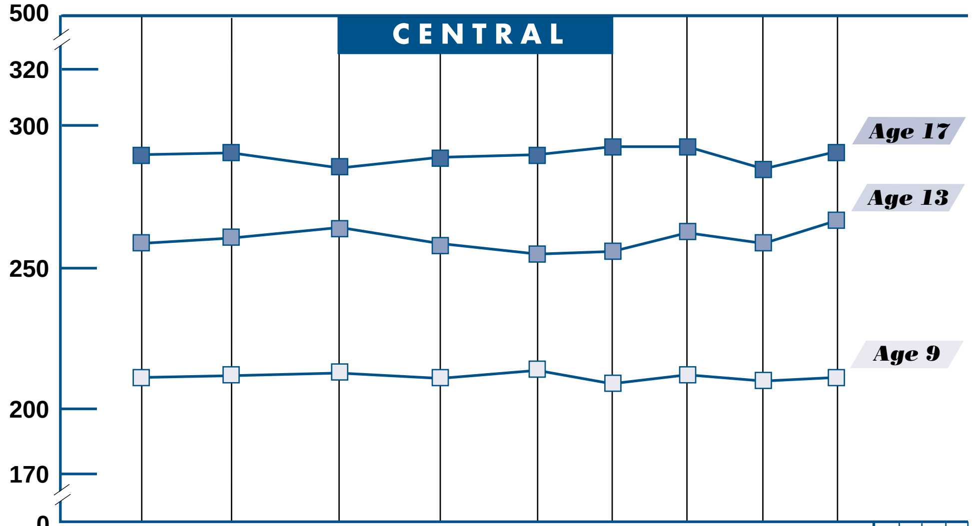
SOUTHEAST



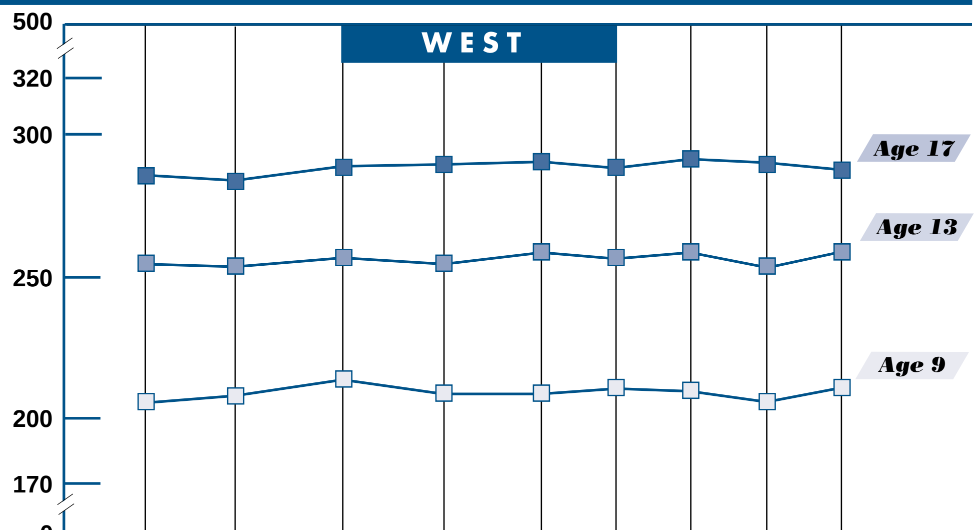
	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	271(2.4) 20(1.8)	277(1.4) 20(0.8)	280(2.2) 21(1.9)	285(1.6) 22(1.8)	286(2.1) 23(1.0)	285(2.5) 23(0.9)	278(2.9) 25(1.4)	284(2.8) 25(1.7)	280(2.6) 24(2.9)			+	–
Age 13	245(1.7) 24(2.2)	249(1.5) 22(1.1)	253(1.6) 24(2.7)	256(1.5) 23(1.7)	258(2.2) 24(1.4)	256(2.2) 23(0.8)	254(2.5) 23(1.6)	253(2.5) 22(1.6)	251(3.3) 26(2.7)			+	–
Age 9	194(2.9) 22(1.7)	201(1.2) 22(0.8)	210(2.3) 24(2.3)	204(1.6) 24(1.2)	207(2.1) 25(1.7)	197(3.2) 24(1.2)	199(2.0) 23(1.4)	208(3.0) 24(1.5)	206(2.8) 24(2.4)	+			

Figure 5.7 (continued)

Trends in Average Reading Scale Scores by Region, 1971 to 1996



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	291(2.1) 30(2.4)	292(1.4) 30(1.2)	287(2.2) 28(3.2)	290(1.4) 27(1.7)	291(1.9) 26(1.8)	294(2.4) 27(1.0)	294(2.1) 25(0.8)	286(3.7) 26(1.4)	293(2.1) 25(0.9)				
Age 13	260(1.8) 29(2.2)	262(1.4) 28(1.3)	265(1.4) 26(3.5)	259(1.0) 27(1.6)	256(2.0) 26(2.0)	257(1.5) 24(0.7)	264(3.0) 26(1.0)	260(3.3) 27(1.6)	267(1.8) 22(1.1)				
Age 9	215(1.2) 29(2.0)	216(1.2) 26(1.2)	217(1.4) 25(3.4)	215(1.5) 27(1.3)	218(2.2) 24(0.6)	213(2.0) 25(0.7)	216(1.6) 28(1.1)	214(2.3) 26(1.0)	215(2.6) 25(1.2)				



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	284(1.8) 24(2.4)	282(1.9) 25(1.1)	287(2.1) 28(2.3)	288(1.1) 26(0.6)	289(1.8) 28(1.1)	287(2.6) 28(0.9)	290(2.3) 29(1.0)	288(2.8) 27(0.9)	287(2.4) 29(2.1)				
Age 13	254(1.3) 23(2.3)	253(1.7) 26(1.1)	256(2.0) 26(2.3)	254(0.9) 27(0.5)	258(2.1) 28(1.0)	256(1.6) 30(0.9)	258(1.6) 29(1.2)	253(2.1) 31(1.1)	257(1.7) 30(2.2)				
Age 9	205(2.0) 23(1.9)	207(2.0) 25(1.1)	213(1.8) 28(2.1)	208(1.5) 28(0.5)	208(2.6) 29(1.1)	210(2.8) 29(0.8)	209(2.3) 27(0.9)	205(2.8) 28(1.0)	210(1.9) 28(2.4)				

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1971.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Reading Scale Scores by Parents' Highest Level of Education from 1971 to 1996

Educators continue to express concern for the literacy development of students who are considered to be "at risk" (that is, students who are in circumstances that inhibit academic achievement). It has become increasingly clear that environmental influences outside of school are at least as important as classroom experiences in helping students to develop the skills and motivations for becoming lifelong readers and learners.[15] One factor that may be related to a supportive environment for literacy development is the education level of students' parents.

Figure 5.8 presents information regarding levels of parents' education reported by students and the average student reading scale scores associated with them. It is noteworthy that there has been a decrease since 1971 in the percentage of students at all ages who reported that neither of their parents had finished high school. A corresponding increase was observed in the percentage of students at all ages who reported that at least one of their parents had pursued post-high school education. It should also be noted that across the trend assessments approximately one-third of 9-year-olds and one-tenth of 13-year-olds responded "I don't know" to the question about their parents' highest level of education. Furthermore, some research has revealed the potential for young children to provide inaccurate reports about such information.[16]

As in previous NAEP assessments, the 1996 results indicated that students who reported higher levels of parental education attained higher average reading scores. However, at ages 9 and 13 the differences in average scores were not statistically significant between students whose parents' highest level of education was high school graduation and their peers whose parents had not graduated from high school.

At age 17, trend analysis revealed a pattern of improved performance across the assessment years for students who reported the lowest level of parental education, less than high school graduation. However, the 1996 average score for this group of students remained at a level not significantly different from that in 1971. Among students who reported that high school graduation was their parents' highest level of education, average scores fluctuated only slightly during the 1970s and 1980s. The overall pattern was one of decreasing scores, resulting in an average score in 1996 that was lower than that in 1971. An overall pattern of declining performance was observed for students who reported that at least one parent had pursued post-high school education, and in 1996 the average score for these students was lower than that in 1971.

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15 Langer, J. (Ed.). (1987). *Language, literacy, and culture: Issues of society and schooling.* Norwood, NJ: Ablex.
Snow, C., Barnes, W., Chandler, J., Goodman, I., & Hemphill, L. (1991). *Unfilled expectations: Home and school influences on literacy.* Cambridge, MA: Harvard University Press.

16 Looker, E. D. (1989). Accuracy of proxy reports of parental status characteristics. *Sociology of Education, 62*(4), 257-276.

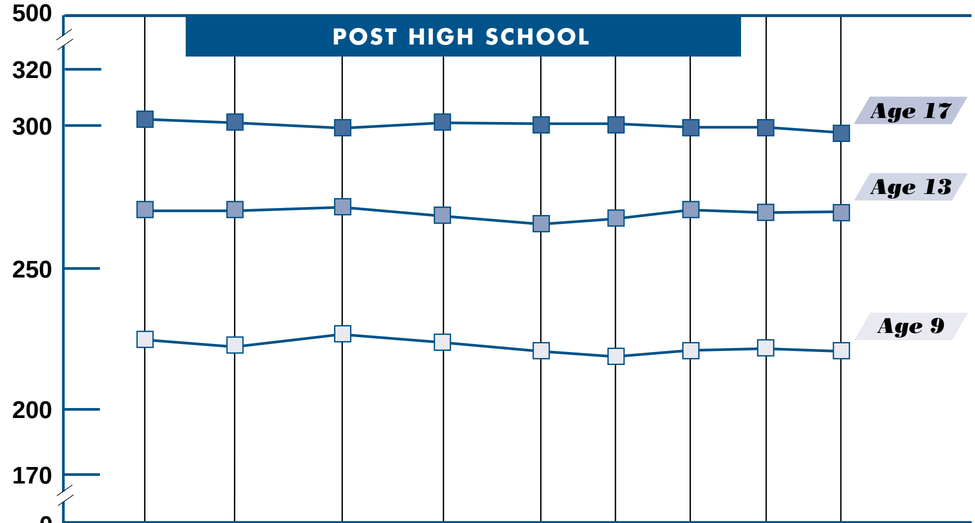
Although slight fluctuations were apparent, there were no significant changes from 1971 to 1996 in the average scores for 13-year-olds who reported that neither parent had graduated from high school or that at least one parent had pursued post-high school education. Thirteen-year-olds who reported that the highest level of education for either of their parents was high school graduation displayed an overall decline in performance. The average score for these students in 1996 was lower than that in 1971.

Among 9-year-olds, no significant changes were observed across the assessment years in the average scores of students who reported that neither parent had graduated from high school or that the highest level attained by either parent was high school graduation. At the highest level of parental education (post-high school) the overall pattern was one of decreasing performance across the assessment years, although there was no significant difference between the 1996 and 1971 average scores.

Figure 5.8

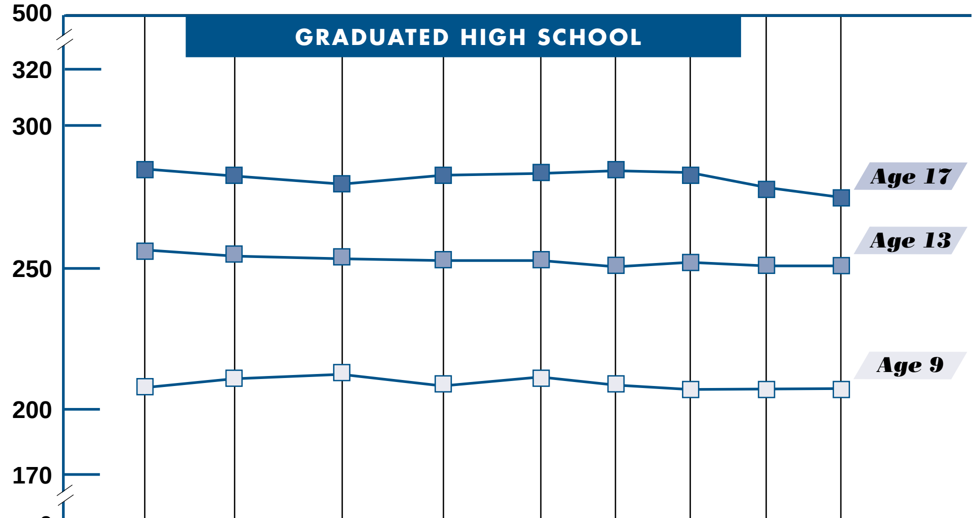
Trends in Average Reading Scale Scores by Parents' Highest Level of Education, 1971 to 1996

POST HIGH SCHOOL



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	302(1.0) 42.(1.3)	301(0.7) 46(0.8)	299(1.0) 51(1.3)	301(0.7) 50(1.2)	300(1.3) 58(1.6)	300(1.1) 58(1.3)	299(1.4) 61(1.4)	299(1.4) 62(1.4)	298(1.2) 63(1.7)	–		–	
Age 13	270(0.8) 38(1.1)	270(0.8) 40(0.9)	271(0.8) 49(1.3)	268(0.7) 46(1.1)	265(1.4) 52(1.5)	267(1.0) 50(1.5)	270(1.4) 57(1.6)	269(1.2) 57(1.5)	269(1.2) 56(1.6)				
Age 9	224(1.1) 33(0.9)	222(0.9) 34(0.7)	226(1.1) 40(1.5)	223(0.9) 37(1.0)	220(1.7) 45(1.4)	218(2.0) 42(1.3)	220(1.4) 45(0.9)	221(1.3) 46(1.2)	219(1.4) 45(0.9)			–	

GRADUATED HIGH SCHOOL



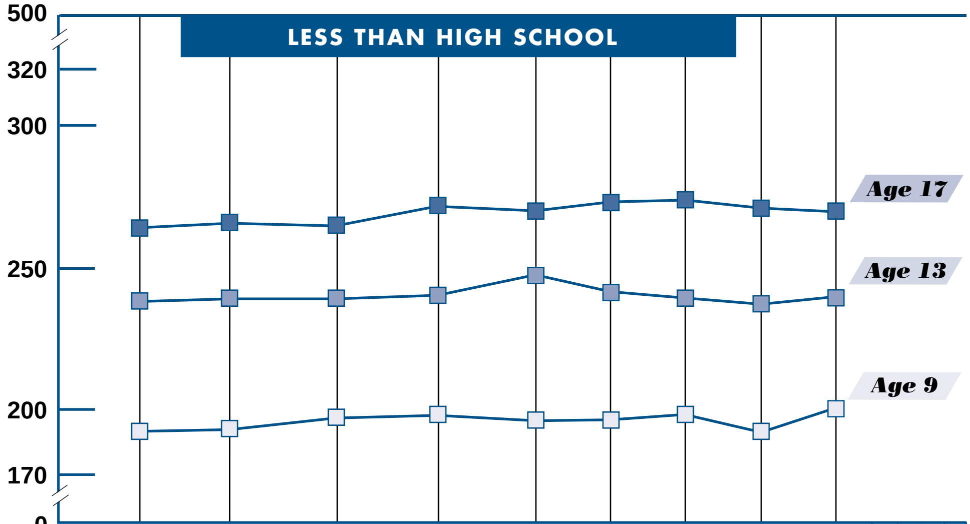
	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	283(1.2) 31(0.8)	281(1.1) 34(0.5)	278(1.0) 32(0.9)	281(0.7) 35(1.0)	282(1.3) 30(1.2)	283(1.4) 30(1.0)	281(1.6) 28(0.9)	276(1.9) 27(1.1)	273(1.7) 27(1.5)	–		–	
Age 13	256(0.8) 32(0.7)	255(0.7) 33(0.6)	254(0.9) 31(0.7)	253(0.7) 36(1.0)	253(1.2) 31(1.1)	251(0.9) 31(1.2)	252(1.7) 28(1.2)	251(1.4) 27(1.2)	251(1.5) 29(1.4)	–		–	
Age 9	208(1.2) 22(0.5)	211(0.9) 24(0.4)	213(1.3) 25(0.8)	209(1.0) 20(0.6)	211(2.2) 16(0.6)	209(1.8) 17(0.8)	207(1.5) 16(0.8)	207(2.6) 16(0.8)	207(2.0) 15(0.7)				

Figure 5.8 (continued)

Trends in Average Reading Scale Scores by Parents' Highest Level of Education, 1971 to 1996

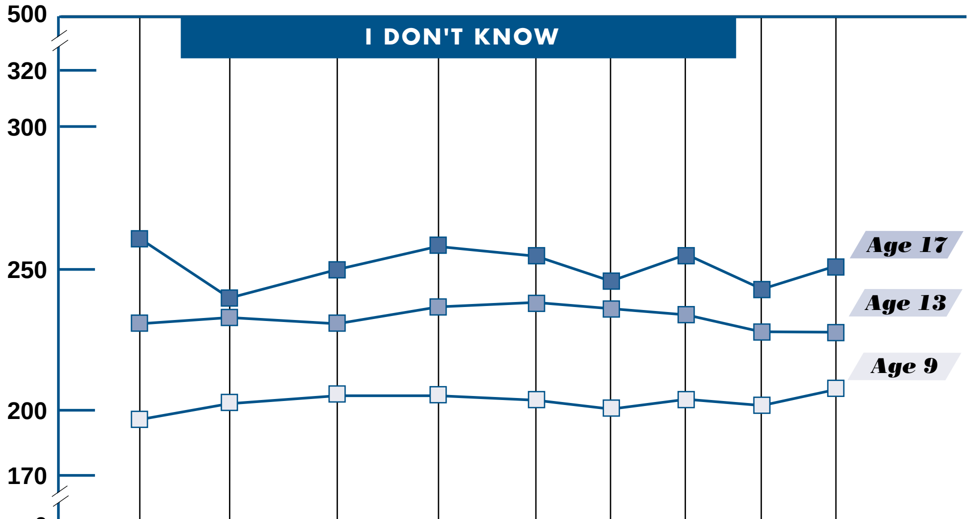
THE NATION'S REPORT CARD naep

LESS THAN HIGH SCHOOL



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	261(1.5) 20(0.8)	263(1.3) 16(0.6)	262(1.5) 13(0.7)	269(1.1) 12(0.6)	267(2.0) 9(0.8)	270(2.8) 9(0.6)	271(3.9) 8(0.8)	268(2.7) 7(0.5)	267(3.2) 7(0.6)			+	
Age 13	238(1.3) 16(0.6)	239(1.2) 14(0.6)	239(1.1) 10(0.6)	240(0.9) 9(0.4)	247(2.1) 8(0.6)	241(1.8) 8(0.6)	239(2.6) 6(0.5)	237(2.4) 7(0.6)	239(2.8) 5(0.5)				
Age 9	189(1.5) 10(0.4)	190(1.3) 10(0.4)	194(1.6) 7(0.5)	195(1.4) 6(0.2)	193(4.9) 5(0.6)	193(3.2) 5(0.5)	195(4.5) 5(0.4)	189(4.0) 4(0.4)	197(3.4) 4(0.4)				

I DON'T KNOW



	1971	1975	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	261(5.0) 7(0.8)	240(2.8) 4(0.2)	250(3.5) 4(0.4)	257(2.0) 3(0.2)	255(6.2) 2(0.3)	246(5.7) 3(0.3)	255(5.9) 3(0.3)	243(5.2) 3(0.4)	252(5.0) 3(0.2)				
Age 13	233(1.0) 14(0.8)	235(1.1) 13(0.6)	233(1.7) 10(0.7)	237(1.3) 10(0.4)	240(3.0) 9(0.7)	238(1.9) 11(0.6)	236(2.6) 9(0.5)	230(3.0) 9(0.7)	230(2.5) 10(0.5)				–
Age 9	197(1.0) 35(0.7)	203(0.8) 32(0.8)	206(1.0) 28(1.0)	204(0.7) 38(0.9)	204(1.5) 34(1.3)	201(1.5) 36(1.1)	204(1.2) 34(1.3)	202(1.3) 34(0.8)	208(1.4) 36(0.9)	+	+	+	

Below each average scale score, the corresponding percentage of students is presented.

Standard errors of the estimated scale scores and percentages appear in parentheses.

* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1971.

‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.

L Indicates that the positive (+) or negative (–) linear trend is significant.

Q Indicates that the positive (+) or negative (–) quadratic trend is significant.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Trends in Reading Scale Scores by Type of School from 1980 to 1996

Students' average reading scale scores by type of school attended are shown in Figure 5.9. Results by school type were first reported in the 1980 trend assessment. Examination of data collected from 1980 through 1996 indicates that the relative percentages of students attending nonpublic versus public schools have remained relatively stable since 1980.[17]

Numerous factors contributing to the differential academic performance of public and nonpublic school students have been highlighted by research. Although some studies point to instructional and policy differences between the two types of schools to explain the higher performance of private school students,[18] other studies have suggested that student selection and parental involvement are more significant contributors to the performance differences.[19] In 1996, 9- and 13-year-olds attending nonpublic schools demonstrated higher average reading scores than did students attending public schools. At age 17, the difference between average scale scores for public and nonpublic school students was not statistically significant.

Public School Students. The average scores for 17-year-olds attending public schools showed improvement from 1980 to 1990 but have since declined. In 1996, the average score for this age group did not differ significantly from the 1980 average score. At age 13, students demonstrated little change in performance across the trend assessments, with no significant differences or overall pattern of increasing or decreasing scores. The average score of 9-year-old public school students declined after the 1980 assessment and has remained relatively consistent since 1984. Although the overall trend was negative, no significant difference was observed between the 1996 and 1980 average scores.

Nonpublic School Students. For students attending nonpublic schools, no significant changes or overall patterns of increase or decrease were observed between 1980 and 1996 in the average scores of all three age groups.

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17 Nonpublic schools include Catholic and other private schools.

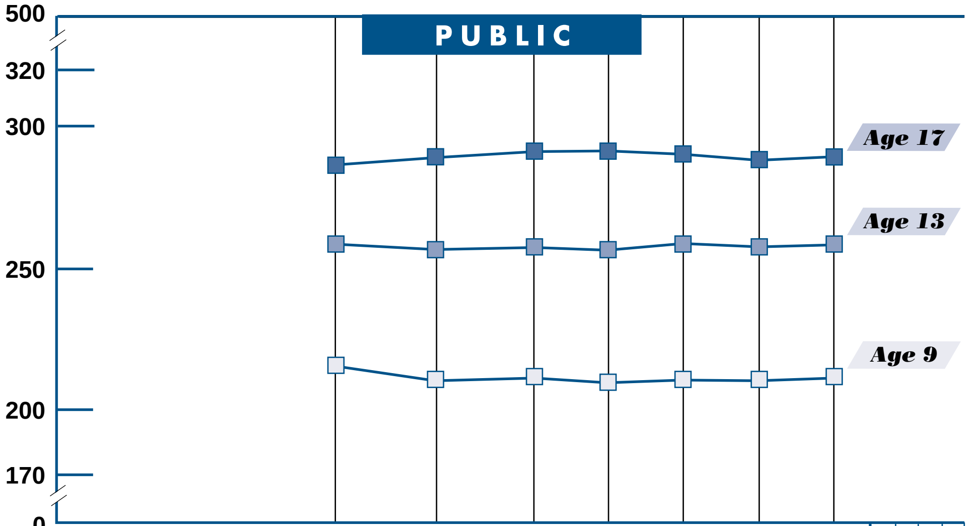
18 Coleman, J., Hoffer, T., & Kilgore, S. (1982). Cognitive outcomes in public and private schools. *Sociology of Education, 55*, 65-76.

19 Alexander, K.L., & Pallas, A.M. (1983). Private schools and public policy: New evidence on cognitive achievement in public and private schools. *Sociology of Education, 56*, 170-182.

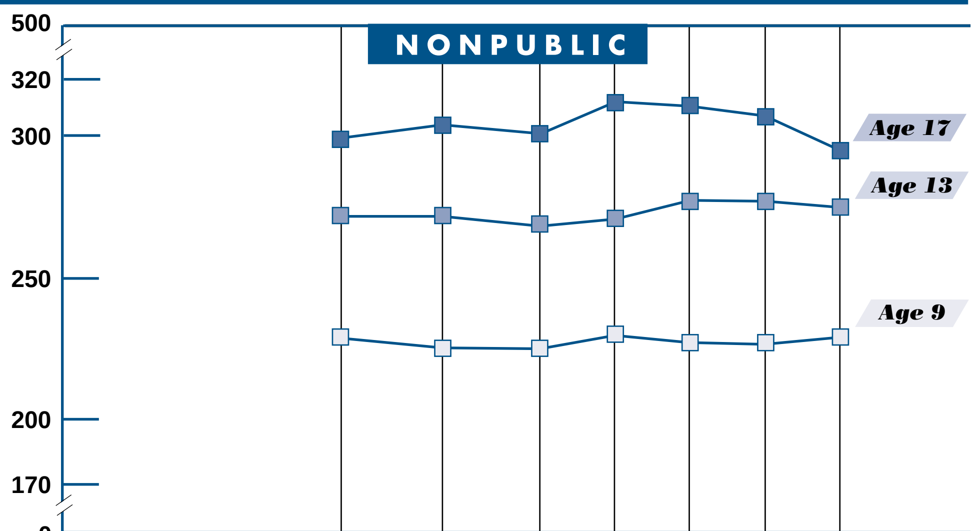
Figure 5.9

Trends in Average Reading Scale Scores by Type of School, 1980 to 1996

THE NATION'S REPORT CARD naep



	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	284(1.2) 93(1.2)	287(0.6) 89(1.7)	289(1.0) 88(3.5)	289(1.1) 93(1.5)	288(1.0) 92(1.9)	286(1.5) 89(2.3)	287(1.1) 92(1.7)				–
Age 13	257(1.1) 88(1.3)	255(0.6) 88(1.1)	256(1.0) 89(2.5)	255(0.8) 88(1.9)	257(1.3) 86(1.9)	256(1.0) 89(1.5)	256(1.1) 89(2.1)				
Age 9	214(1.1) 89(1.4)	209(0.8) 87(1.7)	210(1.2) 88(2.7)	208(1.4) 92(1.9)	209(1.0) 88(1.7)	209(1.4) 89(2.1)	210(1.0) 86(1.6)			–	+



	1980	1984	1988	1990	1992	1994	1996	*	‡	L	Q
Age 17	298(2.7) 7(1.2)	303(2.0) 11(1.7)	300(3.8) 12(3.5)	311(4.2) 7(1.5)	310(4.2) 8(1.9)	306(5.8) 11(2.3)	294(5.7) 8(1.7)				
Age 13	271(1.5) 12(1.3)	271(1.7) 12(1.1)	268(2.8) 11(2.5)	270(2.9) 12(1.9)	276(2.6) 14(1.9)	276(3.4) 11(1.5)	273(3.4) 12(2.1)				
Age 9	227(1.8) 11(1.4)	223(1.6) 13(1.7)	223(3.0) 12(2.7)	228(3.3) 8(1.9)	225(2.3) 12(1.7)	225(2.7) 11(2.1)	227(3.0) 14(1.6)				

Below each average scale score, the corresponding percentage of students is presented.
Standard errors of the estimated scale scores and percentages appear in parentheses.
* Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1980.
‡ Indicates that the average scale score in 1996 is significantly larger (+) or smaller (–) than that in 1994.
L Indicates that the positive (+) or negative (–) linear trend is significant.
Q Indicates that the positive (+) or negative (–) quadratic trend is significant.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Summary

- The reading scores of 9-year-olds increased until 1980, but did not continue to improve after that time. At age 13, trend analysis revealed an overall pattern of increasing performance. At both ages 9 and 13, the 1996 average score was higher than the 1971 average. Despite an overall trend toward higher scores for 17-year-olds, the absence of recent gains resulted in an average score in 1996 that did not differ significantly from that in 1971.
- The percentages of 9-year-olds at or above Levels 150 and 200 on the NAEP reading scale was higher in 1996 than in 1971. At age 13, there were increases between 1971 and 1996 in the percentages of students who performed at or above Levels 300 and 350. Increases were also observed for 17-year-olds at or above Levels 200 and 250.
- The overall pattern of average scores across the nine assessments for students in each age group in the upper quartile is one of increased performance. However, the 1996 average score for the top 25 percent of students was significantly higher than the 1971 average for only 9- and 13-year-olds. In the middle two quartiles, the 1996 average scores for 9- and 13-year-olds were higher than the 1971 averages. Despite an overall trend of increased performance for 17-year-olds in this performance range, no significant difference was observed between 1996 and 1971 average scores. In the lower quartile, both 9- and 17-year-old students attained an average score in 1996 that was higher than that in 1971. Early gains that were made by 13-year-olds in the lower quartile have not been maintained, and the 1996 average score was not significantly different from the 1971 average.
- For White students in each age group, an overall pattern of increased performance was present across the assessment years. Among 9- and 13-year-olds, these gains resulted in a 1996 average score that was higher than that in 1971. Black students in each age group have also demonstrated a trend of performance gains since 1971. Although this pattern has reversed during the 1990s, the average score for each age group in 1996 remained higher than the average score in 1971. Among Hispanic students, no overall pattern of increasing or decreasing scores was apparent for 9- and 13-year-olds. Nonetheless, the average score of 9-year-olds in 1996 was higher than that in 1975. At age 17, a period of improvement from 1975 to 1990 was followed by a period of decline, resulting in a 1996 average score that did not differ significantly from that in 1975.
- In 1996, White students in all three age groups outperformed their Black and Hispanic peers. At all three ages, a trend toward smaller gaps between White and Black students' average reading scores is evident across the assessment years. However, for 13- and 17-year-olds this trend shows signs of reversing since the 1988 assessment. Nevertheless, for both 9- and 17-year-olds the gap between White and Black students in 1996 was smaller than it was in 1971. The gap between White and Hispanic students has not changed significantly since 1975 for 9- and 13-year-olds. At age 17, although the gap between White and Hispanic students appeared to have decreased between 1975 and 1990, this trend has not continued into the 1990s. The gap between White and Hispanic 17-year-old students' average scores in 1996 was not significantly different than that in 1975.

- Male 9-year-olds showed overall improvement across the assessment years. Despite relatively little change in recent assessments, their average score in 1996 remained higher than in 1971. For male students aged 13, gains that were observed in 1980 have not been maintained. At age 17, male students' performance declined after a period of gains from 1971 to 1988, resulting in a 1996 average score that did not differ significantly from that in 1971. However, the overall pattern was one of improved performance. Although overall gains were not observed for 9-year-old female students, the average score in 1996 for this group was higher than the average in 1971. Both 13- and 17-year-old female students demonstrated overall gains across the nine assessments. However, the 1996 average score was significantly higher than the 1971 average for 13-year-olds, but not for 17-year-olds.
- In 1996, the average reading scores of female students were higher than those of male students in each age group. For 9-year-olds this gap has remained relatively consistent since 1971. At ages 13 and 17, there was some evidence of a trend toward smaller, then larger gaps since the 1980s, but the 1996 gap did not differ significantly from that in 1971.
- For all three age groups in the Northeast, the trend results reveal no overall pattern of increasing or decreasing scores. However, 9-year-old students in the Northeast attained an average score in 1996 that was higher than that in 1971, and the 1996 average score of the 13-year-olds was lower than the 1994 average. In the Southeast, the average score for 9-year-olds fluctuated across the nine assessments, but was higher in 1996 than in 1971. For 13- and 17-year-olds in the Southeast, a period of increasing scores until 1988 was followed by a period of decline, resulting in 1996 average scores that were not significantly different from 1971 averages. For students at all three ages in the Central region and the West region, no significant changes were observed across the assessment years.
- In 1996, a few significant differences in reading scores were observed between regions. At age 9, students in the Northeast outperformed their peers in the Southeast and West regions. At age 13, students in the Central region outperformed their peers in the Northeast, Southeast, and West regions. And at age 17, students in the Northeast and Central regions outperformed their peers in the Southeast.
- At all three ages, the percentage of students who reported that at least one of their parents had pursued post-high school education increased between 1971 and 1996. For 9-year-olds who reported this highest level of parental education, results from the nine trend assessments indicated an overall trend of decreasing performance. However, the 1996 average score for this group did not differ significantly from the 1971 average. At age 13, a pattern of declining scores was observed for students who reported high school graduation as their parents' highest level of education, resulting in a 1996 average score that was lower than the 1971 average. Among 17-year-olds, students who reported the lowest level of parental education displayed a trend toward higher scores across the assessment years, but the average score of this group in 1996 was not significantly different from that in 1971. For 17-year-olds who reported the two highest levels of parental education, trend analyses revealed an overall pattern of declining scores, resulting in 1996 averages that were lower than those in 1971.

- In 1996, the average reading scores of 9- and 13-year-old students attending nonpublic schools were higher than those of their peers attending public schools. The difference between 17-year-old nonpublic and public school students was not statistically significant. Although the overall trend for 9-year-olds in public schools was one of declining performance, relative stability during the last decade resulted in a 1996 average score that was not significantly different from that in 1980. The average scores for 9-year-olds attending nonpublic schools and for 13-year-olds attending either nonpublic or public schools have not changed significantly since 1980. Among 17-year-olds, the average scores for students in public schools increased during the 1980s but declined thereafter, resulting in a 1996 average score that was not significantly different from the 1980 average.

Chapter 6

Students' Experiences in Reading

Children learn to read through a variety of instructional experiences afforded them by concerned educators. However, the factors that contribute to students' developing reading abilities are numerous and extend beyond the activities of the classroom. In recent years, a growing body of research has pointed to the key role played by the family and home environment in students' reading achievement.[20] This chapter examines trends in students' school and home environments related to literacy development. Since 1984, and in some cases 1971, NAEP has asked students to respond to survey questions about their experiences related to reading development. This information is valuable in helping parents, educators, and policy makers understand how literacy develops and what aspects of a student's experience are related to achievement in reading.

Reading Across the Curriculum

The amount of reading and the types of materials read as a part of instruction are central to the process of learning to read. As such, increased emphasis is being placed on giving students a variety of materials to read and opportunities to use their developing skills as a tool for learning. Most experts agree that developing into a lifelong reader requires exposure to a diverse range of materials and ample opportunities to gain practice in reading.[21] Because of the importance placed on reading across the content areas, NAEP trend assessments have asked students to report the total number of pages they read as assigned schoolwork per day, including reading at both school and home.

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[20] Kellaghan, T., Sloane, K., Alverez, B., & Bloom, B. S. (1993). *The home environment and school learning: Promoting parental involvement in the education of children.* San Francisco: Jossey-Bass.

[21] Flood, J., & Lapp, D. (1994). Developing literary appreciation and literacy skills: A blueprint for success. *The Reading Teacher, 48*(1), 76-79.

Turner, J., & Paris, S. G. (1995). How literacy tasks influence children's motivation for literacy. *The Reading Teacher, 48*(8), 662-673.

Table 6.1 presents students' reports on the number of pages they read per day in school and for homework and their average reading scale scores in both 1984 and 1996. The results indicate that students aged 9 and 13 reported reading more pages per day in 1996 than in 1984. However, no significant changes were observed for students aged 17. Among 9-year-olds, a greater percentage of students reported reading 20 or more pages and a smaller percentage reported reading 5 or fewer pages each day in 1996 than in 1984. At age 13, a greater percentage of students reported reading 20 or more pages and a smaller percentage reported reading 6 to 10 pages each day in 1996 than in 1984.

Table 6.1 **Pages Read Per Day in School and for Homework, 1984 and 1996**

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Number of Pages...	Year	AGE 9		AGE 13		AGE 17	
		Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
More than 20	1996	17 (1.0) *	218 (2.3)	14 (0.7) *	259 (2.3)	21 (1.1)	300 (3.1)
	1984	13 (0.4)	215 (1.4)	11 (0.4)	261 (1.2)	20 (1.0)	299 (1.0)
16 - 20	1996	16 (0.9)	217 (1.9)	13 (0.6)	262 (2.1)	14 (0.7)	296 (2.1)
	1984	13 (0.5)	215 (1.2)	11 (0.2)	263 (1.0)	14 (0.4)	296 (0.9)
11 - 15	1996	15 (0.7)	217 (2.0)	18 (0.8)	265 (2.0)	18 (0.8)	291 (2.1)
	1984	14 (0.5)	220 (1.2)	18 (0.4)	264 (0.9)	18 (0.3)	294 (0.8)
6 - 10	1996	25 (1.0)	215 (1.6)	31 (0.8) *	261 (1.3)	25 (1.0)	285 (1.5)
	1984	25 (0.5)	215 (1.0)	35 (0.5)	261 (0.6)	26 (0.6)	287 (0.8)
5 or fewer	1996	26 (1.1) *	203 (1.6) *	25 (1.0)	250 (1.5)	22 (0.8)	272 (2.5)
	1984	35 (1.0)	208 (0.8)	27 (0.6)	250 (0.7)	21 (0.8)	273 (0.8)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1984.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

As in past NAEP assessments, a relationship between reading scale scores and the number of pages read each day was apparent in the 1996 results. At all three ages, students who reported reading 5 or fewer pages per day for school and homework had lower average scores than students who reported reading more pages. Additionally, 17-year-olds who reported reading only 6 to 10 pages each day had lower average scores than their peers who read 16 or more pages. The results may be viewed as one piece of evidence supporting the assertions of many educators and researchers that reading across the curriculum is an important aspect of students' overall reading development.[22]

[22] Davenport, M. R., Jaeger, M., & Lauritzen, C. (1995). Integrating curriculum: Negotiating curriculum. *The Reading Teacher, 49*(1), 60-62.

Farnan, N. (1996). Connecting adolescents and reading: Goals at the middle level. *Journal of Adolescent & Adult Literacy, 39*(6), 436-445.

Another aspect of students' literacy experiences that contributes to the depth and breadth of their developing skills is their exposure to a wide variety of reading materials. Since 1984, NAEP has asked students to identify which of several types of texts they read a few times a year or more. The types of texts asked about included: poems, plays, biographies, science books, and books about other places. Table 6.2 presents students' responses.

Although some increases were observed in students' reports about exposure to certain types of texts at ages 13 and 17, this was not the case at age 9. According to the reports of 9-year-olds, fewer students were reading poems and plays in 1996 than in 1984. However, at age 13 there was an increase in the percentage of students who reported reading both of these types of materials. Among 17-year-olds, an increase between 1984 and 1996 was observed in the percentages who reported reading biographies and science books.

Table 6.2 **Reading Certain Types of Materials a Few Times a Year or More Frequently, 1984 and 1996**

THE NATION'S REPORT CARD naep

Types of Materials...		PERCENT OF STUDENTS		
		AGE 9	AGE 13	AGE 17
Poems	1996	60 (1.9) *	80 (1.9) *	80 (1.8)
	1984	70 (1.5)	68 (1.3)	76 (1.1)
Plays	1996	42 (2.3) *	67 (2.1) *	67 (1.6)
	1984	56 (1.4)	59 (1.4)	63 (1.0)
Biographies	1996	46 (2.4)	65 (2.6)	66 (1.7) *
	1984	45 (1.5)	62 (1.3)	59 (1.2)
Science Books	1996	83 (2.2)	90 (1.9)	82 (2.0) *
	1984	84 (1.3)	90 (1.1)	70 (1.1)
Books About Other Places	1996	78 (1.6)	84 (1.8)	81 (1.9)
	1984	79 (1.2)	83 (1.1)	81 (0.9)

Standard errors of the estimated percentages appear in parentheses.
* Indicates that the percentage in 1996 is significantly different than that in 1984.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Time Spent on Homework for All Subjects

Another important aspect of students' educational achievement is the time they devote to homework. Table 6.3 presents students' responses regarding time spent on homework and their average reading scale scores. Significant changes were observed at age 9. Among 9-year-olds, the percentage of students who reported not having homework assigned was lower in 1996 than in 1984. Correspondingly, the percentage of students who reported doing less than 1 hour each day increased. However, fewer students reported doing more than 2 hours of homework each day. No significant changes between 1984 and 1996 were observed in the reports of 13- and 17-year-olds regarding the amount of time spent on homework each day.

In 1996, the relationship between amount of time spent on homework and average reading scores varied across the three age groups. Among 9-year-olds, students who reported doing more than 2 hours of homework each day had lower average scores than students who reported doing 1 to 2 hours or less than 1 hour of homework. These results may reflect the additional homework assigned to lower achieving students, or the additional time that these students may require to complete the regularly assigned homework. Nine-year-olds who reported not doing assigned homework had lower average reading scores than students who reported doing 1 to 2 hours or less than 1 hour of homework. Also, 9-year-olds who reported not having homework assigned had lower scores than students who reported doing 1 to 2 hours on homework each day. Students aged 13 and 17 who reported spending 1 hour or more on homework each day had higher reading scores on average than their peers who reported not doing homework or not having homework assigned. Additionally, 17-year-olds who reported doing more than 2 hours of homework each day had a higher average reading score than did students who reported doing 1 to 2 hours or less than 1 hour of homework.

Table 6.3 Amount of Time Spent on Homework for All Subjects, 1984 and 1996

Amount of Homework...	Year	AGE 9 Percent of Students	AGE 9 Average Scale Score	AGE 13 Percent of Students	AGE 13 Average Scale Score	AGE 17 Percent of Students	AGE 17 Average Scale Score
None	1996	26 (1.6) *	210 (1.9)	22 (1.8)	254 (1.3)	23 (1.4)	274 (1.9)
	1984	36 (1.3)	213 (0.9)	23 (0.8)	254 (0.8)	22 (0.9)	276 (0.7)
Didn't Do Assigned Homework	1996	4 (0.3)	196 (5.2)	5 (0.5)	249 (3.3)	13 (0.6)	281 (2.2)
	1984	4 (0.3)	199 (2.1)	4 (0.2)	247 (1.7)	11 (0.3)	287 (1.2)
Less than 1 Hour	1996	53 (1.5) *	215 (1.0)	37 (1.2)	258 (1.6)	28 (0.9)	289 (1.5)
	1984	42 (1.0)	218 (0.7)	36 (0.7)	261 (0.6)	26 (0.4)	290 (0.8)
1 - 2 Hours	1996	13 (0.7)	219 (2.1)	27 (1.2)	266 (1.6)	24 (1.0)	296 (2.1)
	1984	13 (0.5)	216 (1.3)	29 (0.5)	266 (0.7)	27 (0.5)	296 (0.8)
More than 2 Hours	1996	4 (0.3) *	199 (4.5)	8 (0.9)	268 (2.3)	11 (0.7)	307 (3.4)
	1984	6 (0.2)	201 (1.8)	9 (0.3)	265 (1.2)	13 (0.6)	303 (1.1)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1984.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Extent of Reading in the Home at Ages 13 and 17

Social and cultural influences on reading development have received increased attention among educators and researchers in recent years.[23] Not only have researchers come to recognize the important role of family support for literacy, but educators and policy makers are increasingly focusing their attentions on building stronger links between home and school to support students' educational growth.[24] One way in which the home environment can support literacy development is the modeling of reading habits by parents or other adults in the home. Children may come to value the use of literacy materials by observing the important people in their lives engaged in such activities. Furthermore, some research has highlighted the significant effects of home reading activities on both students' reading achievement and their attitudes toward reading.[25]

Since 1984, NAEP has asked 13- and 17-year-olds about the extent of reading in their homes. Students were asked to report how often adults they lived with read newspapers, magazines, or books. Students were grouped in three categories: those who reported that the adults they lived with never read newspapers, magazines, or books, or read these materials very infrequently (i.e., yearly or monthly); those who reported that the adults they lived with read these materials on a weekly basis; and those who said they lived with an adult who read these materials on a daily basis. Table 6.4 presents results from 1984 and 1996 concerning this important aspect of students' home environment.

No significant changes were observed between the two assessment years in students' reports about the extent of reading in their homes. In 1996, the reports of students in both age groups were quite similar: over 80 percent reported that reading newspapers, magazines, or books occurred in their homes on at least a weekly basis. However, 18 percent of 13-year-olds and 16 percent of 17-year-olds reported that reading took place in their homes monthly or less frequently. These students had lower average reading scores than their peers who reported weekly or daily reading activities in their homes.

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[23] Chall, J. S., Jacobs, V. A., & Baldwin, L. E. (1990). *The reading crisis: Why poor children fall behind.* Cambridge, MA: Harvard University Press.

Stevenson, J., & Fredman, G. (1990, July). The social environmental correlates of reading ability. *Journal of Child Psychiatry*, 681-698.

[24] Christenson, S. L. (1992). Family factors and student achievement: An avenue to increase students' success. *School Psychology Quarterly, 7*(3), 178-206.

Morrow, L. M. (Ed.). (1995). *Family literacy: Connections in schools and communities.* Newark, DE: International Reading Association.

[25] Fox, B. J., & Wright, M. (1997). Connecting school and home literacy experiences through cross-age reading. *The Reading Teacher, 50*(5), 396-403.

Rowe, K. J. (1991, February). The influence of reading activity at home on students' attitudes toward reading, classroom attentiveness, and reading achievement: An application of structural equation modeling. *British Journal of Educational Psychology, 61*, 19-35.

Table 6.4

Extent of Reading by Adults in the Home, 1984 and 1996

Extent of Reading in the Home...	Year	AGE 13 Percent of Students	AGE 13 Average Scale Score	AGE 17 Percent of Students	AGE 17 Average Scale Score
Never/Yearly/Monthly	1996	18 (1.8)	244 (4.6)	16 (2.3)	270 (4.3)
	1984	16 (1.0)	245 (2.0)	14 (0.8)	268 (2.3)
Weekly	1996	40 (2.1)	262 (3.4)	45 (2.4)	286 (3.1)
	1984	43 (1.1)	259 (2.0)	44 (1.1)	288 (1.5)
Daily	1996	42 (2.3)	266 (2.8)	39 (2.2)	295 (3.7)
	1984	41 (0.9)	263 (1.8)	42 (1.4)	292 (1.6)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1984.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Exposure to Reading Materials in the Home

The availability of reading materials in the home increases opportunities for students to develop as readers and also demonstrates for students the importance of literacy in our daily lives. Because of the potentially significant effects of access to reading materials on students' reading development, NAEP has asked students since 1971 whether they have access to newspapers, magazines, books, and encyclopedias in their homes. Students' responses and average scale scores in 1971 and 1996 are presented in Table 6.5.

Overall, the results indicated a decline in the number of reading materials in the home between 1971 and 1996. At age 9, a smaller percentage of students in 1996 than in 1971 reported having all four types and a greater percentage reported having 2 or fewer types in their homes. At ages 13 and 17, the percentage of students who reported having all four types of reading materials also dropped, while the percentage who reported having 3 or fewer types of materials increased.

Data from 1996 relating the number of different types of reading materials in the home to students' average reading scores indicated a clear pattern across all three age groups: more types of reading materials in the home was associated with higher average reading scores.

Table 6.5 Numbers of Reading Materials in the Home, 1971 and 1996

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Numbers of Types of Materials in the Home...	Year	AGE 9 Percent of Students	AGE 9 Average Scale Score	AGE 13 Percent of Students	AGE 13 Average Scale Score	AGE 17 Percent of Students	AGE 17 Average Scale Score
0 - 2	1996	35 (1.4) *	200 (1.6) *	22 (0.8) *	238 (1.4) *	18 (0.9) *	267 (2.6) *
	1971	28 (0.8)	186 (1.0)	17 (0.6)	227 (1.3)	11 (0.6)	246 (1.8)
3	1996	35 (1.1)	215 (1.4) *	32 (0.7) *	256 (1.4) *	28 (1.1) *	286 (1.6) *
	1971	33 (0.4)	208 (1.0)	25 (0.5)	249 (0.9)	22 (0.5)	274 (1.4)
4	1996	30 (1.1) *	225 (1.6)	46 (1.0) *	270 (1.4)	53 (1.3) *	296 (1.5)
	1971	39 (0.9)	223 (0.9)	58 (1.0)	267 (0.7)	67 (0.9)	296 (1.0)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1971.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

Independent Reading Habits

Choosing to spend time reading independently may be one indication of developing lifelong literacy habits. Furthermore, some research has revealed a positive relationship between independent reading and reading achievement.[26] Because of the importance placed by educators and parents on students' independent reading habits, NAEP has asked 9-, 13-, and 17-year-olds

[26] Watkins, M. W., & Edwards, V. A. (1992). Extracurricular reading and reading achievement: The rich stay rich and the poor don't read. *Reading Improvement, 29*(4), 236-242.

since 1984 about how much time they spend reading for fun. Table 6.6 compares the responses provided by students in 1984 and 1996.

No significant changes were observed in the amount of time 9- and 13-year-olds reported reading for fun. At age 17 there was some evidence that students were reading for fun less frequently in 1996 than in 1984: the percentage of 17-year-olds who reported reading for fun daily was lower, and the percentage who reported never reading for fun was higher. These results may be viewed as disappointing, since over a decade ago the publication *Becoming a Nation of Readers: The Report of the Commission on Reading* recommended that "children should spend more time in independent reading."[27] Unfortunately, since 1984 little progress in this area has been observed.

In 1996, 9-year-olds were more likely to read for fun on a daily basis than were 13- or 17-year-olds. Daily reading was reported by more than one-half of students aged 9, but by less than one-third of students aged 13 and by about one-fourth of students aged 17. Based on 1996 results, those students who reported daily reading for fun had higher average reading scores than students who reported never reading for fun.

Table 6.6 **Frequency of Reading for Fun, 1984 and 1996**

Frequency of Reading...	Year	AGE 9		AGE 13		AGE 17	
		Percent of Students	Average Scale Score	Percent of Students	Average Scale Score	Percent of Students	Average Scale Score
Daily	1996	54 (1.9)	213 (2.0)	32 (1.9)	269 (3.3)	23 (2.0) *	302 (5.2)
	1984	53 (1.0)	214 (1.1)	35 (1.0)	264 (1.4)	31 (0.8)	297 (1.5)
Weekly	1996	27 (1.8)	212 (2.6)	31 (2.1)	258 (3.2)	32 (2.7)	293 (4.0)
	1984	28 (0.8)	212 (1.7)	35 (1.2)	255 (1.4)	34 (1.1)	290 (1.7)
Monthly	1996	8 (1.0)	210 (5.0)	15 (1.4)	259 (4.6)	17 (1.5)	290 (5.6)
	1984	7 (0.6)	204 (3.3)	14 (0.8)	255 (2.1)	17 (0.5)	290 (1.8)
Yearly	1996	3 (0.5)	*** (***)	9 (1.2)	*** (***)	12 (1.6)	285 (5.6)
	1984	3 (0.3)	197 (4.2)	7 (0.5)	252 (3.6)	10 (0.5)	280 (2.7)
Never	1996	8 (0.8)	199 (4.3)	13 (1.5)	236 (4.8)	16 (2.1) *	270 (5.0)
	1984	9 (0.5)	198 (2.7)	9 (0.6)	239 (2.5)	9 (0.6)	269 (2.4)

Standard errors of the estimated percentages and scale scores appear in parentheses.
* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1984.
*** Sample size is insufficient to permit a reliable estimate.
SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[27] Anderson, R. C., Hiebert, E. H., Scott, J. A., & Wilkinson, I. A. G. (1985). *Becoming a nation of readers: The report of the commission on reading.* The National Institute of Education. Wasghinton, DC: US Department of Education.

Students who develop into lifelong readers display numerous literacy habits and practices. For example, discussing and sharing books with others has been identified as an important literacy activity.[28] Social interaction related to reading may help students view themselves as contributing members of a literacy community. Students who borrow books from the library or who buy books demonstrate a commitment to reading and their own literacy development. Students who seek, select, and read books written by an author they prefer show a strategy for reading material selection.[29]

Because of the importance of these activities for literacy development, NAEP reading assessments since 1984 have asked students whether or not they have engaged in four specific reading-related activities: telling a friend about a good book, taking books out of the library, spending their own money on books, and reading more than one book by an author they liked.

Table 6.7 presents the percentages of students in 1984 and 1996 who reported ever engaging in any or all of these four activities, and their average reading scores. The results indicate no significant change since 1984 in the percentage of students engaging in these activities. At all three ages in 1996, one-half or less of the students reported engaging in all four activities. Given the potential importance of these literacy habits, it may be of particular concern that approximately one-fifth of 17-year-olds reported engaging in 0 to 1 of these activities. In all three age groups, students who reported engaging in all four activities had higher average reading scores than students who reported engaging in only 0 to 1 of the activities.

Table 6.7 **Engagement in Reading-Related Activities, 1984 and 1996**

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Number of Activities...	Year	AGE 9 Percent of Students	AGE 9 Average Scale Score	AGE 13 Percent of Students	AGE 13 Average Scale Score	AGE 17 Percent of Students	AGE 17 Average Scale Score
0 - 1	1996	8 (0.8)	200 (3.2)	14 (1.4)	232 (4.6)	21 (2.2)	268 (5.5)
	1984	10 (0.5)	205 (2.5)	12 (0.8)	242 (2.1)	17 (0.8)	271 (1.7)
2	1996	12 (1.0)	207 (4.9)	13 (1.7)	256 (4.2)	9 (1.6)	*** (***)
	1984	16 (0.8)	208 (1.7)	14 (0.8)	246 (2.6)	14 (0.6)	282 (2.1)
3	1996	32 (1.6)	210 (2.6)	25 (2.2)	256 (2.7)	26 (1.7)	285 (3.7)
	1984	31 (1.0)	211 (1.8)	25 (0.9)	255 (1.5)	23 (0.7)	289 (1.8)
4	1996	48 (1.3)	215 (2.1)	48 (1.6)	268 (3.2)	44 (3.1)	305 (3.3)
	1984	44 (1.0)	216 (1.5)	49 (1.1)	264 (1.3)	47 (1.3)	298 (1.6)

Standard errors of the estimated percentages and scale scores appear in parentheses.

* Indicates that the percentage or average scale score in 1996 is significantly different than that in 1984.

*** Sample size is insufficient to permit a reliable estimate.

SOURCE: National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 1996 Long-Term Trend Assessment.

[28] Snow, C. E., Barnes, W. S., Chandler, J., Goodman, I. F., & Hemphill, L. (1991). *Unfulfilled expectations: Home and school influences on literacy.* Cambridge, MA: Harvard University Press.

[29] Hiebert, E. H., Mervar, K. B., & Person, D. (1990). Research directions: Children's selection of trade books in libraries and classrooms. *Language Arts, 67,* 758-763.

Summary

- Students aged 9 and 13 reported reading more pages per day in school and for homework in 1996 than did their counterparts in 1984. However, no significant change in pages read per day was observed for 17-year-olds. In 1996, students at all three ages who reported reading 5 or fewer pages each day in school and for homework had lower average scores than students who reported reading more than 5 pages.
- Although the percentages of 9-year-olds who reported reading poems and plays at least a few times a year decreased between 1984 and 1996, there was an increase in the percentage of 13-year-olds who reported reading these materials. At age 17, students' reports indicated an increase between 1984 and 1996 in the reading of biographies and science books a few times a year or more frequently.
- The reports of 9-year-olds indicated an increase between 1984 and 1996 in the amount of time spent on homework each day. No significant changes were observed for 13- and 17-year-olds. In 1996, the relationship between time spent on homework and average reading scores varied somewhat across the three age groups. Among 9-year-olds, students who reported doing more than 2 hours of homework each day had lower average scores than students who spent less than 1 hour or 1 to 2 hours each day. However, the average score of 9-year-old students who reported not having assigned homework was lower than that of students who reported doing 1 to 2 hours of homework. Among 13- and 17-year-olds, doing 1 hour or more of homework each day was associated with higher average reading scores, compared to those of students who did not do their homework or did not have homework assigned. For 17-year-olds, the highest average reading score was attained by students who reported doing at least 2 hours of homework each day.
- No significant changes between 1984 and 1996 were observed in the extent of reading by adults in 13- and 17-year old students' homes. Students in both age groups who reported that adults in their homes read newspapers, magazines, or books on at least a weekly basis had higher average scores than students who reported less frequent reading of these materials by adults in their homes.
- At all three ages, students' reports indicated a decline between 1971 and 1996 in the number of different types of reading materials in the home. In 1996, increased number of types of reading materials in the home was associated with higher average reading scores.
- No significant changes between 1984 and 1996 were observed in the amount of time 9- and 13-year-olds reported that they spent reading for fun. At age 17, there was a decrease in the percentage of students who reported reading for fun on a daily basis, and an increase in the percentage who reported never reading for fun. In 1996, those students in each age group who reported reading for fun on a daily basis had higher average reading scores than their peers who reported never doing so.

- At all three ages, no significant changes between 1984 and 1996 were observed in students' reports about their engagement in reading-related activities: telling a friend about a good book, taking books out of the library, spending their own money on books, and reading more than one book by an author they liked. In 1996, students in each age group who reported that they had engaged in all of these activities had higher average reading scores than their peers who had engaged in 1 or none of these activities.